August 1960

Agriculture

Volume LXVII Number 5

Harvest break

Published for the Ministry of Agriculture, Fisheries and Food
by Her Majesty's Stationery Office

ONE SHILLING MONTHLY

Agriculture

Volume LXVII Number 5 August 1960

EDITORIAL OFFICES
THE MINISTRY OF AGRICULTURE, FISHERIES AND FOOD
WHITEHALL PLACE · LONDON S.W.1 · TRAFALGAR 7711

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Cover photograph: Harvest break *Photo: Farmer's Weekly*

Farm Management and the Best Use of Capital

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Increased mechanization, more intensive production, and high prices for farms have drawn attention to the importance of capital in agriculture. This article discusses some of the principles which govern its use.

THE publicity which farm management now receives has drawn attention to some of the economic principles on which successful farming depends. One of the most important of these is the greater significance which marginal costs frequently assume over average costs. In deciding whether or not to intensify production, it is not enough to know that present costs are less than the market price; much more important is the additional cost of increasing the present output. This will depend on the circumstances of the individual farm: it could be infinitesimal in relation to the returns, or it could be so great as to swallow up the whole value of the extra output. In milk production, for example, an extra gallon might be produced at no greater cost than the conventional amount of extra concentrates required, and the profit on it would therefore be considerable, even at summer prices of milk. But if to produce more milk meant extra cows and extra buildings to house them, the additional capital cost might easily add 4*d*. a gallon to the overheads—before taking any account of the extra food required, the depreciation on the cows, and any other expenses that might be involved.

The concept of marginal costs is utilized in the new farm management technique of programme planning. Here the *gross* profit (output less *variable* costs) is computed per acre and per £1 wages for all the probable enterprises on an individual farm. Then, bearing in mind the precepts of good husbandry and such restrictions as may be imposed by, say, the acreage limitations in the sugar beet contract, the enterprises for the individual farm are selected according to the returns they offer per acre of land and per £1 wages. The protagonists of this method would be the first to admit, however, that there is a weakness in it until equal attention is paid to the capital requirements which a modification in system involves. This is an acknowledgment of a change that has overtaken farming comparatively recently, for in the last twenty years there has been a big increase in the capital equipment of all farms. Capital, indeed, has now become so important in farm organization that the absence of adequate information on the returns to it of the different farm enterprises, similar to that available on land and labour, is a handicap felt keenly whenever changes in farming plans are under consideration.

Proper use of capital

The principle behind the expenditure of capital, whether long or short term, is the same as for land and labour: if the return by investing it in a certain enterprise is greater than would be obtained by investing it elsewhere,

then the expenditure is justified (provided it does not mean that labour is drawn away from more remunerative enterprises, or that it uses land which was already contributing more to the total farm income). In fact, the returns to land, labour, and capital must all be considered at the same time if the most profitable arrangement of farm enterprises is to be achieved. If capital were treated in isolation, it would frequently be found that growing more corn would yield a greater return than any alternative enterprise, for the capital requirements of increasing the corn acreage might, in fact, require little more than the seed corn and the extra fuel needed for the cultivations. This is assuming that the land was previously under grass, when capital might actually be saved because of the investment in the livestock which would no longer be required for grazing it. Consequently any profit which resulted from the corn, taken in isolation, would represent an enormous return on the extra capital required to produce it. Whether it resulted in an increase in the total farm profit, however, would be known only when the reduction in income from the sale of livestock (or their products) had been assessed.

Capital can be used either to increase output or reduce expenditure. If the increase in production will pay the cost (that is, the interest and depreciation on the capital plus any incidental costs which may also be involved), the venture will be a profitable one for the individual, although if too many producers act on this principle the cumulative effect may upset the market.

Capital expenditure in times of overproduction

When there is some danger of overproduction, capital spent in reducing costs will generally be a more satisfactory way of increasing net profits than will capital directed to higher outputs. Draught-excluding improvements to a piggery may so reduce the liveweight/food consumption ratio that the cost will be small in relation to the saving in expenditure on feedingstuffs. Similarly, a little capital spent in reorganizing farm buildings, of which work study exercises provide many examples, may reduce considerably the hours of labour on livestock. This by itself will not improve the net profit unless the surplus labour can be discharged or used profitably on some other job. Frequently the most practical solution is to increase the number of stock under the care of the same labour. This increases the total production, with the advantage of reducing its unit cost and the possible disadvantage of overloading the market. In practice, capital expenditure is most likely to increase profits by reducing total costs when it can be used to replace bought by home-grown foods, for bought foods can be reduced in small amounts, and not by the large "lumps" such as when a regular man is discharged or an expensive item of equipment is not renewed. A machine which will assist silage-making, enabling more home-grown food to be fed and some concentrates to be saved, will help to reduce costs—if the costs of making the silage are low enough to produce starch equivalent and protein more cheaply than it can be bought as cake. (Even so, care must be taken to see that this saving is not counterbalanced by the loss in income from not growing the crop which silage has replaced. The individual cannot afford lightly to dispense with bought foods if they increase the value of his output by more than they cost.)

Can you afford not to borrow?

Economics studies the use of scarce resources, and capital is one of these. In fact, capital can be regarded as scarce on any farm where the return by using more of it is greater than could be obtained if it was invested outside farming. In theory, the marginal return on the capital in each of the enterprises on a farm should be the same, for if the return in one enterprise is greater than in another, it will pay to increase the capital in the first and reduce that of the second until the returns on both become the same (as they will eventually, on the principle of diminishing returns). In practice, it is often more likely that the return on capital in most enterprises would justify extending them, if only the capital were available. This leads to the subject of credit. Borrowing is no new experience to most farmers, but usually it is resorted to as a necessity, and not by choice. In fact, farmers frequently refuse to undertake a worthwhile development until they have saved the money to pay for it. Yet if they would borrow it as soon as the advantages of a loan became apparent their income would be augmented by the difference between the profit it earned and the interest which was paid. No man can afford not to borrow money at, say, 6 per cent if he can see a return of 10 per cent on it.

Rates of interest on borrowed money vary, however; the more a man borrows, the less security he has to offer, and the higher do the rates of interest usually rise. This is one reason for the high rates charged by hire purchase companies—much more than the rates advertised, if allowance is made for the fact that some capital is paid back almost immediately and the *average* debt over the period of the loan is only half as much as the initial sum on which the interest charge is made. Yet to take advantage of hire purchase is worth while if the loan allows a higher return to be made than the total instalments cost, and if there is no better way of acquiring the capital.

Increasing mechanization

A feature of British farming in the last twenty years has been the increasing amount of capital invested in machinery. A recent example of its advantages in suitable circumstances is provided by a study of sugar beet growing in Yorkshire. In 1959, average costs of man, tractor and horse labour on 36 farms which all grew more than 30 acres of beet were £11 an acre less than on a similar number of farms which grew less than 10 acres. Yet the yield of beet and the gross return were rather greater, and the profit was higher by almost 50 per cent. The main advantage was in the saving of manual labour through the greater degree of mechanization and other advantages of scale.

It would, nevertheless, be a mistake to infer that all the capital invested in machinery has been profitably employed, and that more mechanization is always a good thing in itself. In 1946, according to Ashby and Smith,* the amount of work performed per man as measured by the acres of crops grown

* Labour Organization on Farms. A. W. Ashby and J. H. Smith. *J. agric. Econ.*, 1948,: 7, 351–75.

and numbers of livestock kept in England and Wales was only 98 per cent of what it had been in 1939. Unpublished work in the University of Leeds suggests that, in the East Riding of Yorkshire, twice the expenditure (in real terms) on machinery was required in 1957 compared with 1939 for a "performance" which was greater by only one-sixth. Without claiming any great accuracy for the method, and allowing for the relative costs of labour and machinery, the result of this calculation is sufficiently striking to suggest that either mechanization had been carried too far, or that the machines were not being used to best advantage.

Pursuing the same theme, a comparison of net output per £100 labour and machinery on individual Yorkshire farms provides little evidence of any advantages in heavy mechanization. While medium-sized farms derived some advantage over small holdings, in general the largest farms, with combines, driers, and grain store facilities, had no greater output from their expenditure on labour and equipment than the medium-sized farms which still harvested with binders. This study is still in its early stages, so that it would be unwise to attempt a complete explanation of the situation at present. But of several tentative suggestions perhaps the most cogent is that so many machines in British agriculture become obsolete before they are worn out. The introduction of diesel tractors caused many vaporizing-oil tractors to be jettisoned for this reason; the change in popularity in corn driers from the platform sack variety to the ventilated bin type and now to continuous flow illustrates the same tendency. The advantage of the new over the older or less fashionable type is increased by the system of initial allowances for tax purposes.

These examples draw attention to the ways in which capital may be spent unwisely or unfortunately. They do not affect the principle that expenditure on capital is always justified when the extra return exceeds the extra cost, or the equally important principle that when there is a shortage, what capital is available should be applied where the return on it is likely to be greatest. And while management standards, which help so much to assess the output of crops and livestock and the efficiency of labour, are much less complete on capital, the technique of partial budgeting to show the likely return on the investment of extra capital can be applied on an individual farm as successfully as in measuring the return to other resources.

Wintering the Hill Flock

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The question of how best to winter ewe lambs on a hill farm cannot be divorced from the problem of wintering the hill flock as a whole.

PRODUCTION from a flock of hill sheep may be increased either by breeding more efficient animals or by improving the environment. Improvement through breeding is, at best, a slow process, especially with hill sheep; but changes in the management of the flock, within its total environment, can have a substantial effect on production.

The chief limiting factor in the environment of hill sheep is the discrepancy between the demands of the flock and the feed available in February, March and April. Before the grass starts to grow in the spring, the pastures are bare just when flock demands are rapidly increasing. Anything that can be done to close the gap during this vital period will have a profound effect on flock production.

Since the problem is one of imbalance, improvement can be twofold, by ensuring that flock demands are at their minimum in relation to potential production and feed supplies are at their maximum at this time of year. A survey of some North Wales hill farms, carried out some years ago, throws light on several of the factors involved in achieving these objects, some of which can easily be overlooked.

It is important to achieve the right stocking rate—so that under-nutrition in the vital late winter months is not too severe, and yet numbers are high enough to keep up with the summer grazing. Overstocking accentuates the problem of finding wintering for ewe lambs, and where this occurs the flock is very vulnerable in a hard winter. The problem is most acute where there is common and sometimes uncontrolled grazing on unenclosed mountains; under these conditions a fairly dense summer stocking is needed to maintain the territory of each flock. Any reduction of stocking by an individual flock-owner may be nullified by the encroachment of neighbouring flocks. The real solution, in the long run, is for mountain grazing rights to be fenced where possible, thus allowing each flock-owner full control over stocking rate.

Flock age structure

The usual practice in mountain areas of Wales is for hill ewes to be drafted to the lowland at 4½ years old, after rearing three lambs on the hill. Their sale forms an important part of the output of Welsh hill flocks. But the advantages of retaining the ewes a year longer on the hill are worth serious consideration. Many experienced hill farmers would agree that the sound-mouthed four-year-old ewe is quite capable of rearing at least one extra lamb on the hill.

In the survey mentioned, it was calculated, on the basis of the numbers of ewes drafted in relation to the number of ewe lambs retained, that mortality in some North Wales hill flocks averaged 7–8 per cent per year from the age of six months to 4½ years. This means that in a flock selling 4½-year-old draft ewes, about 39 ewe lambs must be retained per 100 productive ewes (those in the three age groups producing lambs), and for this number about 28 4½-year-old draft ewes would be sold. Of the productive ewes, 36 per cent would be shearlings lambing for the first time. If such a flock changed over to retaining ewes to an average age of 5½ instead of 4½ years, and mortality remained unchanged, only about 30 ewe lambs would need to be retained, and only 20 5½-year-old ewes would be sold. In addition, only about 28 per cent of the productive ewes would be shearlings. Ignoring the beneficial effect of a lower proportion of shearlings on flock production, although there would be now eight less draft ewes there would be at least nine more lambs to sell. Furthermore there would be nine fewer ewe lambs to winter, a drop of 23 per cent—an important consideration in view of the difficulties of obtaining wintering facilities.

Against these considerations it may be argued that the 5½-year-old ewe would be less attractive to the lowland buyer. It is often found, however, that hill ewes drafted to the lowland suffer heavier mortality from various causes when retained for more than one season, so that a slightly older ewe might not be unduly penalized.

The wider implications of such a change on the draft ewe trade would, of course, merit careful consideration.

Wintering ewe lambs

The two measures already outlined aim at ensuring a minimum winter burden, especially of replacements, without jeopardizing the flock's productive potential. In view of the very low proportion of wintering land in relation to summer carrying capacity on hill farms, further measures have to be taken to augment wintering resources. One method of doing this is by "borrowing" extra land; and it is the traditional practice in the hill areas of Wales to send ewe lambs, and sometimes some of the ewes, to lower farms for wintering. The high cost and scarcity of good wintering in recent years has focussed attention on alternative methods of wintering lambs.

It should be remembered that ewe lambs have traditionally been sent away to winter, not simply for their own welfare, but because all the available land at home had to be kept for the ewes in the hungry gap months around lambing. The apparently substantial reductions in cost achieved with some alternative methods of wintering ewe lambs can turn out to be false economy, if there is a reduction in the feed available for the ewes at a time when they can ill afford it. This adverse competition can set up a vicious circle by leading to higher losses and poorer lambing performance which, in turn, mean an increased burden of replacements. The use of kale or foggage, for instance, to provide keep in early winter can lead to serious competition with the ewes just when this should be avoided.

Wintering lambs in sheds, entirely on purchased feed, is rather different, in that the lambs are still technically "off the farm". The danger of this system is the real temptation to try to reduce the amount of hand feeding

by getting the most out of grazing, and allowing the lambs to run out on a substantial area. The loss of even a small area of good grazing in late winter can be unfavourable for flock production.

The possible merits of home wintering systems can be judged only if careful consideration is given to the complete flock as a unit, and to the demands of that unit for space and feed during the winter period.

Supplementary feeding

Although the hill ewe is capable of withstanding some degree of under nutrition during pregnancy, supplementary feeding can help to reduce the gap in food supplies. Much more information about the nutrition of the hill ewe at this stage is needed to formulate rational feeding practices, and many practical difficulties would be involved in the feeding of a scattered hill flock. Because the ewe's demands are greatest in early lactation, feeding in the first few weeks after lambing may be as important as feeding during pregnancy. The encouragement of a good milk yield at this time would ensure strong lambs for turning up to the mountain. Supplementary feeding could be adopted as regular practice for shearling ewes and, more flexibly, for older ewes during hard winters. This would leave the hill farmer less at the mercy of fluctuating seasons, especially on many heavily-stocked Welsh farms.

The "ffridd", or enclosed lower reaches of the mountains, is an integral part of the Welsh hill farming system, and a great deal hinges on the full use of these limited areas. Steps have to be taken to fit them for the task of supporting a dense stocking during February, March and April.

Where possible this land should be kept free of sheep during the summer, to provide fresh land for winter use. It can economically support a beef suckling herd in the summer, but its importance to the sheep flock must be kept in mind; it should be cleared early enough in the autumn to reserve some growth for the ewes. Since the land is required in late winter, every effort should be (and in many hill areas is) made to keep the ewes on the mountain as long as possible. Just *how* long will depend largely on the season: but the flock can be brought down in stages—weak ewes and shearlings first, the stronger ewes later. One disadvantage of an undivided "ffridd" is that although the pasture may be adequate when the ewes come down in January or February, it is soon bared under the dense stocking. It is therefore useful to sub-divide this land to some extent, so that some fresh ground is available around lambing time. After lambing, the ewes can again be turned up to the mountain in stages, turning the ewes with the strongest lambs first.

The measures outlined, already part of good hill farming practice in some areas, are basically sound. Where they can be put into effect, the methods of doing so should be judged from the needs of the whole flock as a unit.

Protective Flora of Sea Walls

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Mr. Trist considers couch grass is the best vegetative cover for sea defence banks, but he does not exclude other species. A small pilot experiment has been conducted in Essex, and full-scale demonstrations of the use of couch and other species are being planned.

BEFORE the sea floods of January 1953, the cover of natural flora on walls protecting low-lying land from the tidal rivers and the sea had largely been left to its own devices. Where erosion was occurring on the face of the wall, the natural cover was reinforced with concrete or stonework; whilst in some places reinforcement by earth-work sufficed.

After the 1953 flooding of the east coast marshes, long lengths of tidal river and sea walls were almost entirely rebuilt, and subsequently reseeded or faced with local turf cut from the saltings. In this article, I shall discuss the flora which provides a protective covering and some of the plants which should be controlled.

First it is necessary to know the plants which can withstand varying conditions in the proximity of sea water. This can mean occasional to frequent coverings by salt spray and, at high spring tides, complete covering by salt water for several hours at a time. Plants which are to thrive under such conditions must vary in degree of salt tolerance. Secondly, the plant cover must serve a purpose in preventing soil erosion of the wall. It should therefore be capable of forming a dense cover with a type of rooting system which binds the clay, thus adding strength to the mass of the defence and an outer cover to act as a buffer against wave action.

Unsuitable sowings

There can be no legitimate criticism of the methods used in the reseeding of sea walls after the 1953 rebuilding, for the work to be put in hand was a big undertaking and there was no practical alternative. Nevertheless, whatever type of grass is sown under any conditions, the best result is not obtainable where the plants cannot be given some attention. The new wall sowings consisted largely of perennial ryegrass and cocksfoot. Ryegrass, like many other plants, makes poor growth in poor conditions, and cocksfoot, if not managed, will grow into single plant tussocks. Under little or no management, both will fail to knit up into a tight sward and with upright, tussock-like growth will leave bare ground between the plants; neither can make a root-binding contribution to the strength of the wall.

Where it is not possible to carry out much cutting or grazing, the entry of weeds is inevitable. Both broad leaved and curled docks (*Rumex obtusifolius* and *R. crispus*) are deep rooted, and on a sea wall cause small open fissures which under drought conditions develop into larger cracks. Mugwort (*Artemisia vulgaris*), with its comparatively short, branching root system and

erect growth, can be overlooked and does not compete with grass growth. On the other hand, common orache (*Atriplex patula*), with its procumbent branches and dense spread, will completely crowd out newly-sown grasses and only grow in a bare space on a wall where natural grasses are established. But shore orache (*Atriplex littoralis*), with its erect growth, is comparatively harmless to a new seeding—unless it is thick on the ground.

Creeping thistle (*Cirsium arvense*) is as undesirable in new seedings on a river wall as it is elsewhere. Common mallow (*Malva sylvestris*) can grow into quite a large plant on the walls. The lower stems, with their decumbent growth, together with the fairly dense cover of leaves, will crowd out both young and established grass. Common reed (*Phragmites communis*) can be tolerated to some degree, for its tall, erect growth allows grass to thrive underneath; but it has a far-reaching, strong horizontal root system and a root which will attain one inch in width. A freshly cut reed-infested marsh ditch shows the drainage property of *Phragmites* roots and their ability to keep the soil open. In a dry period, surface cracks would meet these root channels. Such a condition is not desirable on a sea wall.

Plants for the seaward face of the wall

These few plants are mostly confined to the rear of the wall, and although this is not as vulnerable as the face of the wall, the sward should be kept close for protection against back scour of tidal overspills. On the face of the wall, both grasses and other plants must be highly tolerant of salt conditions. Herbaceous seablite (*Suaeda maritima*) can be found as a small plant, harmless and making no contribution. Sea purslane (*Halimione portulacoides*), with its decumbent stems, forms a fairly dense cover of tough leaves, with a good hold of short creeping rhizomes, enabling the plant to withstand tidal action and form a protective covering for the wall. Beet (*Beta vulgaris* ssp. *maritima*), which can be found on the face, top and rear of tidal walls, should be regarded as a nuisance.

Under present conditions of management, in my opinion the best grass cover, certainly for face of tidal walls, is found in the *Agropyron* spp. This is illustrated by what is found on the old-established covers, and is fortunately now taking the place of the reseedings following the 1953 floods. These species have the advantage of long creeping rhizomes growing closely together, to form a mat of roots which bind the soil. Couch grass (*Agropyron repens*) is very useful to form a dense sward on the rear of the wall. Sea couch grass (*Agropyron pungens*), also with strong creeping rhizomes, has the added advantage of salt tolerance and is able to face tidal spray and inundation. In addition, this *Agropyron* species can form a dense ground cover of strong leaf and stem, and is therefore an excellent buffer against the tide to prevent wall erosion.

This view is not generally held, for *Agropyron pungens* can develop an open sward of single, tussock-like plants which fail to provide the desirable dense cover. This situation is normally seen only when fresh colonization takes place on bare areas following a bank slip, or where the cover has been eroded. Sward repairs following such incidents need more attention than they get. New cover may be planted out in early spring, with single plants of *Agropyron pungens* stripped off established plants on the wall and heeled

in behind a spade at one foot intervals. An alternative is to dig up rhizomes and heel them a few inches into the bank soil. No plants growing on the face of the wall should be robbed of growth, and this suggested repair material should be taken from the rear of the wall. Following this method of sward repair, the young shoots of grass should be cut or grazed on the same principle as any other sward establishment, to encourage tillering and consequent knitting of the sward, and avoid single tussock growth.

The view is also held that this grass will create a loose mat of dead debris into which young roots penetrate with inadequate hold, and that the subsequent new growth is not capable of withstanding erosion. This is a fact, but can be avoided. It is likely that little critical work has been carried out on the recovery response to cutting in this species, but it should be borne in mind that in former years *Agropyron repens* and *pungens* have been successfully grazed hard on both the marsh level and on sea walls, especially by sheep.

Other grass covers

It would, however, be wrong to exclude the possible success of other grass covers, and experimental work will need to take into account the following factors:

1. The general nature of the habitat, especially in relation to salinity.
2. The variable soils necessarily used in wall construction, which present a problem of natural consolidation, and are often very acid and extremely low in phosphate.
3. The management required by new species to effect a quickly-knitted, dense cover; and subsequent attention to maintain such a condition, by cutting or grazing and adequate application of fertilizers.

On the rear face of the wall, creeping bent (*Agrostis stolonifera*) makes a useful binding contribution, growing with *Agropyron repens*. Squirrel-tail grass (*Hordeum marinum*) also tolerant of salt conditions, may be found on the folding and back face of the wall, but its weak growth does not make much contribution to sward density. One other species of *Agropyron* which is tolerant of salt spray is *A. junceiforme*, but its habitat is more confined to dunes, where its sand binding qualities are valuable, together with lyme grass (*Elymus arenarius*) and marram grass (*Ammophila arenaria*).

Beta vulgaris ssp. *maritima*, like its cultivated relative sugar beet, will grow on a wide range of soils from light sand to heavy clay. On the coast, it is found on sandy shores and the face, top and rear of protective clay walls. Its root habit is unlike that of the cultivated variety. The root is more or less round, with a diameter of up to 3 inches at the crown, tapering to $\frac{1}{4}$-inch, and will grow to a length of $2\frac{1}{2}$–3 feet. Where old plants continue to thrive on the top of the wall, the root cavity will cause a vertical fracture in the clay, and this can be the start of more serious trouble on the tidal face, where water movement in a root hole can start erosion. It should therefore be considered as important to stop as a rat hole. One or two mature plants rooting behind a $2 \times 2\frac{1}{2}$-feet concrete tidal protection slab are capable of easing it gradually out of position. In addition, the foliage of the plant is detrimental to the important grass cover of the wall. The stems branch and lie on the ground; the leaves are broad and form a dense central rosette. A

large plant can almost cover 8 sq. feet of ground which would more usefully be occupied by sea couch (*Agropyron pungens*).

Effects of spraying

In 1958 and 1959 the N.A.A.S. in Suffolk, with the concurrence of the East Suffolk and Norfolk River Board, carried out spraying trials on a tidal river wall at Landguard, near Felixstowe, to find out the most effective spray against wild beet. In 1959, the prolonged summer considerably reduced the growth of this plant, and its reaction to sprays was more marked. In 1958, a very wet summer, the plants appeared to have more resistance to spraying.

Early June spraying in 1958 showed in the following September that MCPA, MCPB, CMPP and 2,4-D ester had little effect: 2,4-D in acid soil emulsion was effective. In 1959, under very dry conditions, sprayed plants recovered from CMPP and 2,4-D acid in oil at 2 lb per acre. There was still a partial recovery of the plants from 2,4-D acid in oil at 3¾ lb per acre, and the sea couch grass (*Agropyron pungens*) was severely scorched. The use of 2 lb 2,4-D + 1 lb 2,4-5T gave full control of the wild beet, but scorched sea couch grass, whilst amino-triazole at 4 lb an acre killed all the beet plants and all the sea couch grass in the plot. With 2 lb per acre MCPA, there was a complete kill of beet plants and no harmful effect on the sea couch grass.

No clear-cut decisions can be made from these two trials, but some of the sprays used can definitely be eliminated, and the results of others are supported by a trial in Suffolk carried out by Gibbs of Rothamsted Experimental Station. Both MCPB and CMPP are ineffective: MCPA gave full control in 1959 (which confirmed Gibbs in 1958) and had no harmful effect on the wall grasses: 2,4-D ester had little effect in 1958, but in the same year Gibbs obtained a satisfactory kill of the plants: 2,4-D amine showed some promise, but the acid in oil is of doubtful use, more especially at higher rates when it causes grass scorch. Amino-triazole and 2,4-5T gave effective control of both beet and grass cover, and as the latter is the desirable protective wall covering, these sprays defeat the object.

Where wild beet plants have been destroyed by chemical spray or by chopping out, the problem of seedlings remains for another year. Following the 1953 sea floods, when seeds were floated out of the grass mat of sea walls, wild beet germinated in the improved conditions found on the marsh level. The seeds can remain viable for several years, and given sufficient moisture to germinate, more especially in an open position, new healthy plants will grow.

Bare areas resulting from successful spraying, or from erosion and subsequent repairs, can be filled in with grass transplants. For small areas, the value of sowing a grass seed mixture is questionable. The use of some species of grass under certain soil conditions needs careful consideration. In spite of the fact that a sea wall provides perfect drainage, it does not follow that cocksfoot, as a drought-resistant plant, is a good selection. Although its root system is comparatively deep, it has no rhizomatous soil-binding properties.

I am grateful to the East Suffolk and Norfolk River Board, and to Mr. F. C. Smith of Searsons Farm, Trimley, for permission to carry out the spraying trials on the sea wall; also to Mr. G. R. Field, the District Advisory Officer, who carried out the observations on the trials.

Helpful Insects

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It is common belief that the majority of insects are pests and could well be done without. Of the 21,000 or more different kinds found in this country, however, comparatively few cause serious damage to crops and livestock and are therefore inimical to the interests of man in the winning of his food from the soil. But what of the remainder? Does it matter if many helpful insects die along with the pests?

LIFE is like a gigantic jigsaw puzzle. Some animals, including insects, feed directly upon plants, while many more feed upon other animals. Many ways of "making a living" have been evolved, and in any single locality various forms of plants and animals which have become adapted to the prevailing climatic and other conditions can be seen living in very complicated and inter-related associations. Though insect populations, as with those of other animals, sometimes reach immense proportions, they are generally kept at comparatively low and fluctuating levels, and these levels are determined by various environmental conditions such as climate, food supply, virus and other diseases and the activities of other animals preying upon them. The part played by predatory animals in regulating insect populations must vary greatly and is doubtless not always indispensable, but frequently it is one of the most important elements in the machinery of natural control.

These animals are of many kinds, such as birds, reptiles, mammals, spiders, mites, and insects, and it is insects with which we are principally concerned in this article. Those which live by attacking other living insects can be put into two classes—predators and parasites.

Predators: (1) Ladybirds

Among the most familiar predatory insects are ladybirds. Over forty kinds are found in Britain, and with one exception they and their larval stages feed upon aphids, thrips, scale insects and other small insects and mites. The beetles, which are frequently red or yellow with black markings, hibernate in sheltered places such as under loose bark and dense vegetation, tending to collect together in large numbers, and often the same winter quarters are used annually. In spring they emerge to pair and lay their eggs. These are usually long oval in shape, bright shining yellow, and placed on end in small clusters, and the six-legged larvae or grubs ("niggers") are commonly of a dark slaty blue, often with yellow spots. When fully fed they form a plump chrysalis, marked with yellow and black in many of the common kinds, and attached by its tail to a leaf. A single larva of the two spot ladybird is said to account for some 200–500 aphids in its life of three weeks.

The female beetles, at any rate of some common kinds, are rather hap-

hazard in the laying of their eggs, not necessarily placing them near aphid colonies, and the newly-hatched larvae, though persistent in their search for aphids, are unmethodical. In consequence many probably perish from starvation after a long period of wandering, or through cannibalism, for ladybird grubs will eat eggs or larvae of their own kind. After leaving hibernation quarters, ladybirds tend to collect where there are early aphid colonies (for example, on stinging nettles), not reaching crops such as beans until aphid infestations on these have reached considerable size. Their effect on aphid populations on the common crops has yet to be measured, but at least under some conditions it seems to be of significance, and it is probably of importance in reducing the numbers of aphids surviving to carry over infestations into following seasons.

Aphids are not, however, quite the "sitting ducks" that might be imagined, for some kinds are distasteful or even toxic to ladybird larvae, while others move away from an approaching larva, even dropping from the plant; or if seized by a limb may kick out and struggle free minus part of the limb or, as a last resort, exude from their cornicles drops of oily fluid which spread a waxy film over the larva's head and immobilize it for a considerable time.

A less familiar ladybird is the minute black *Stethorus punctillum* (Wei.), an almost spherical beetle only 1/25th inch in diameter, with a hairy brown larva 1/10th inch long when full grown. This insect, with two generations in the year, feeds on the fruit tree red spider mite, the beetle eating an average of about twenty adult female mites a day, while the larva sucks eggs as well as mites, averaging some twenty-four mites a day. It also preys upon the glasshouse red spider mite on hops.

Several other groups of beetles are predatory, including the tiger beetles, ground beetles and rove beetles. A minute, shining black rove beetle, *Oligota flavicornis* Boisd., 1/25th inch long, eats the fruit tree red spider mite and its pale yellow larvae suck the mite's eggs. Most rove beetles live in or near the soil, and species are known (*Aleochara*) which prey upon the eggs and pupae of the cabbage root fly. The clerid beetle *Opilo mollis* L. feeds on caterpillars of the winter moth and related species.

(2) Lacewings

The lacewings are also important predators, attacking aphids, suckers, leafhoppers and other small insects and red spider mites. The green lacewings, with bright green bodies and transparent green wings netted with many veins and cross-veins, are moderately large insects, and one common species (*Chrysopa carnea* Steph.) hibernates as an adult. This is often attracted to lighted windows in the autumn. The pale greenish eggs are laid in batches, each egg on the summit of a hair-like stalk. The six-legged larvae are bristly, usually whitish, green or yellowish with red, brown, or black markings, and the slender curved jaws shaped like callipers are used for piercing and sucking their victims. These larvae are often seen with aphid colonies, though, except in some seasons, perhaps not so frequently as ladybirds and hoverflies. They were unusually common last summer. The brown lacewings are smaller, with brownish wings, and have similar habits.

The powdery lacewings by contrast are small fragile insects, with body and wings covered with a fine white powdery substance, so that in some ways

they resemble a greenhouse whitefly. Four species are known to prey on the fruit tree red spider mite. The larvae of the more common one of these (*Conwentzia pineticola* End.) are whitish but become marked with deep red or brown after they have begun feeding on red spider mites. This lacewing seems to occur either sparsely or plentifully, and was abundant in some Essex and Kent orchards in the fine summers of 1947 and 1949, where it was found almost solely in association with red spider mites on fruit trees, though occasionally also on neighbouring hedges. Both adults and larvae eat the mites and their eggs, the larvae sucking out the contents and leaving behind an empty skin or egg shell. They will eat 15–35 mites a day, while the adults have been seen to eat 30 female mites in an hour. There are two or three generations a year, the larvae of the last feeding late in the autumn, when they live almost entirely on the winter eggs, and have been known to reduce the number of live eggs by 90 per cent. The winter is passed as a chrysalis in a white silken cocoon under loose bark.

(3) Hoverflies

Hoverflies, which are frequently banded with wasp-like black and yellow colours, are well known from their habit of remaining poised in the air on rapidly vibrating wings. The larvae of a number of species feed upon aphids, and they are probably among the more important of predatory insects; red spider mites and moth caterpillars are also attacked by some kinds.

In contrast with ladybirds, hoverflies—at any rate species of *Syrphus*, *Scaeva* and *Platycheirus* so far studied—lay their eggs close to aphid colonies. The adult flies feed upon nectar and pollen and appear to be attracted by yellow flowers. When ready to lay eggs the female is also attracted by green parts of plants which would lead her to areas of young growth where aphids are most likely to be found, and through her sense of smell she is stimulated into laying eggs by the presence of aphid colonies. Thus egg laying tends to occur on the most heavily infested plants and where there are large aphid colonies. Some species also lay eggs on plants bearing aphids on their roots.

The eggs are small and cylindrical, pale yellow, and the larvae which hatch in a few days are soft bodied, legless maggots with wrinkled skin. They are voracious feeders, one having been seen to eat 21 large aphids in twenty minutes, and another consumed nearly a thousand in its life-time. The chrysalis stage occurs on a leaf or stem, and the insects overwinter as larvae or chrysalids. Hoverfly larvae may be seen with colonies of many kinds of aphids, and on brassica crops they seem to be the commonest predator. They are numerous in some seasons and must reduce aphid numbers considerably.

Other predatory flies worth brief mention are the stiletto flies (*Thereva*). Their larvae, which resemble long, white wireworms in general appearance, live in the soil and prey upon other insects, including wireworms.

(4) Capsid and related bugs

The last major group of predatory insects to be considered is the capsid and related bugs. These may be best known as pests, but some sixteen pre-

datory species of capsid have been found on fruit trees, where they prey upon the fruit tree red spider mite, and also aphids, thrips and other mite species. The most important, as it is likely to be the most numerous in cultivated as distinct from unsprayed orchards, is the black-kneed capsid. This is a bright green bug about 3/16ths inch long, with orange or reddish eyes, and a narrow black band at the base of the long joint of each leg.

Eggs are laid in late summer; on apple the female prefers the softer tissues of one- or two-year-old shoots, in which she cuts slits to bury her eggs, the site of each slit becoming marked in a few days by the development of a smooth rounded bump. The eggs hatch from late May to early August the following year, with a peak near the end of June. The young bugs live for periods varying from 25 to 53 days before they become adult. The adults begin to appear in July, and the females may persist until October. Both adults and young run swiftly about the leaves searching for red spider mites. An adult female may eat on average 60–70 spider mites a day, or around four thousand in a season.

The related anthocorid bugs include several common species which prey upon small insects such as aphids, scale insects, suckers, caterpillars, midges, and also the fruit tree red spider mite. The *Anthocoris* species are small bugs, about ⅛ inch long, patterned with black and yellowish brown, and three have been noted in orchards. Adult females of *A. nemorum* (L.) overwinter under bark, leaves, etc., emerging in March and April, when they often congregate on willow catkins. They insert their eggs beneath the epidermis of leaves and have two generations a year. The adults have been found to consume an average of 50 red spider mites a day, also sucking the winter eggs in autumn and spring and warm winter days. The young bugs are shiny brown and their exploratory stabs sometimes irritate fruit pickers. Two *Orius* species with rather similar habits are also important. The significance of these predatory bugs in the orchard will be discussed later.

Although not insects, the typhlodromid mites should be mentioned among the predators, for under certain circumstances they seem to be of potential importance as enemies of red spider and other mites on fruit crops.

Parasites

Parasitic insects are to be found mainly in the two great orders including, on the one hand, bees, wasps and ants, and on the other the two-winged flies. They are so numerous that they cannot be discussed in any detail, and although much remains to be discovered about them, they must certainly be of great importance as enemies of insect pests.

The parasitic wasps include over 1,800 species of ichneumons, nearly 900 species of braconids, and over 2,000 species of chalcids and related families. Ichneumons and braconids attack a wide range of creatures, including spiders, the larvae of flies, beetles, sawflies, lacewings, but more especially the caterpillars of butterflies and moths, and some parasitize aphids. The larvae of some feed externally on the body of their host, but most live inside it. When full grown they form their chrysalis stage either within or outside the collapsed skin of their host, some building silken or papery cocoons. In some species the larvae are gregarious, and the cluster of yellow cocoons of *Apanteles glomeratus* (L.) by a dead large white butterfly caterpillar is a

familiar sight. Parasitized aphids, for example by *Aphidius* or *Diaeretus*, are swollen and frequently of a pale straw colour.

The chalcids, some of which are the smallest known insects, parasitize eggs, larvae and pupae of insects, including butterflies and moths, flies, scale insects and aphids. It has been found that some parasitic wasps kill their hosts, not only by parasitism but also by piercing their bodies with their ovipositors and feeding on the fluids exposed.

Few estimations on the effect of parasitic wasps seem to have been made. In the case of the Diamond-back moth, parasitism of 90 per cent of a population has been observed, and there are other records of similarly high control effects on other pests. On the other hand, in an investigation on cabbage aphid in 1953 and 1954 the highest percentage of parasitized aphids noted was 7·2.

Most of the parasitic flies belong to the family of which the houseflies, greenbottles, and blowflies are also members. More than 200 species are found, their larvae being in the majority of cases internal parasites of earthworms, snails, beetles, sawflies, grasshoppers, flies, and more especially the caterpillars of butterflies and moths. In only a few species (e.g., *Compsilura*) is the female equipped with a piercing ovipositor at her tail for laying eggs, such as is characteristic of parasitic wasps.

The parasites attack their victims in many singular ways. In some species the eggs hatch in the female's body and actual larvae are deposited; these, in *Dexia* for example, are spiny and active, capable of moving considerable distances in the soil in search of host caterpillars or grubs. *Tachina* and *Carcelia* glue their eggs to the bodies of caterpillars, into which the larvae bore when they hatch. Others deposit larvae with a protectively armoured skin on the leaves of plants, and these wait for an opportunity of seizing and entering a passing caterpillar. Others again lay eggs on leaves which do not hatch until swallowed by a caterpillar. In such cases the chances of finding a suitable host are obviously small, and to allow for this the female fly produces enormous numbers—many thousands—of young. When fully fed, parasitic fly larvae enter the chrysalis stage inside the skin of the host, or leave it and enter the ground, forming a reddish-brown puparium.

Control of insect pests

In the control of insect pests, parasitic and predatory insects have a special advantage over physical factors such as adverse weather. The latter probably destroy only the same proportion of an insect population whether this is large or small; the effectiveness of the former tends to increase as the insects upon which they prey become more numerous. As their food supply becomes more readily available so they are able to flourish and multiply. Attempts to measure the actual extent to which predators and parasites reduce pest numbers in this country have been started only comparatively recently, but it is reasonable to suppose that the combined effects of the various kinds described in this article must often be at least in part responsible for the seasonal fluctuations noticed in the incidence of pests, and frequently it must be of considerable value.

The potential importance of predators and parasites is illustrated by events which follow when insect pests are accidentally transported to a new country.

There are many instances of this. The insects, finding themselves in favourable surroundings and without their natural enemies, have become far more abundant and destructive than they were in their natural home. Further, the deliberate introduction of their predators and parasites has in a number of cases met with considerable success.

Control of introduced pests by establishing their natural enemies has in fact become an accepted method, though it has been pointed out that the number of successful ventures has so far been relatively small, and it is argued that the method is more likely to succeed in islands or isolated continental areas and in the tropics rather than in temperate zones. This, it is suggested, is because in such places the relatively small fauna is less likely to include species which might attack introduced beneficial insects, and continuous breeding would be favoured by the equable climate.

Parasites as allies

In Britain direct use of parasites has only been made against two pests, both of which are believed to be introduced insects. One, the woolly aphid, probably came originally on apple stocks from the U.S.A. The parasitic chalcid *Aphelinus mali* Hald., was introduced in 1922 and again in 1938, after which it established itself in some Kent and Essex orchards in considerable numbers. Its numbers can be maintained more successfully by overwintering shoots bearing parasitized aphids in apple cold stores at 39–46°F, which are then distributed in the orchard towards the end of May—that is, at a time later than that of natural emergence and when the weather is more favourable and the woolly aphid has begun to breed. Parasitized aphids are often seen in orchards, and it seems that the parasite helps considerably in keeping woolly aphid in check, at any rate in most seasons, although it may suffer setbacks in wet summers.

The second pest, the glasshouse white fly, was probably imported on ornamental plants. In 1926 the parasite *Encarsia formosa* Gahan was discovered in a Hertfordshire garden; numbers were reared, distributed in glasshouses heavily infested with white flies, and a marked control of the pest obtained. *Encarsia formosa* is a minute insect, and under warm glasshouse conditions it can produce successive generations of individuals which are all females; it is also winged and can fly considerable distances. A single egg is laid in each nymph or "scale" of the white fly, and attacked scales change from the normal pale greenish-white to black about ten days after the parasite egg hatches. In cucumber and hot houses the parasite is said to be capable of eradicating severe white fly infestations in two months. As it cannot well survive winter glasshouse conditions, reintroduction is advisable each spring. Its use has declined in recent years, however, probably through conflict with chemical control measures necessary for other pests such as red spider mite, but a fresh investigation of its biology and potential value has been undertaken.

As to our native pests, any attempt to control them by breeding and releasing their predators and parasites would not at present seem to be a practical proposition. Ways may be found of adjusting the environment in some cases so that the activity of these natural enemies is encouraged, though the relationships between their populations, those of their hosts and other

factors in the environment are so complex that they may prove difficult to manipulate. One problem will be that of evening out the fluctuations in pest populations associated with the regulating effects of predators and parasites.

Flare-back

In the meantime we must consider to what extent farming practices may reduce or even eliminate the usefulness of these natural enemies of pests, with particular concern for the effects of insecticides, fungicides and weed-killers. Many of these chemicals are applied to crops with evident success, and this will continue to be the case; but experience has already shown that their use carries elements of danger. The two principal undesirable effects which have occurred through destruction of predatory and parasitic insects are resurgence or "flare-back" of a pest (that is, an increase in numbers after applications of insecticide), and the rise of what have been called "man-made" pests. These effects have occurred particularly with modern insecticides, most of which are persistent and kill a wide range of insects.

So far roughly one species in a hundred of the world's pests has staged such resurgences. The species include white flies, moths, leaf-mining flies, and springtails, but more especially aphids, scale insects and red spider and other mites. Aphids and mites, in particular, with several generations in the year and a high breeding potential, are likely to increase to alarming numbers following spraying with insecticides which, though killing a high proportion of the pest, also destroy the predators and parasites. This has been demonstrated in this country with strawberry and cabbage aphids. For example, when Brussels sprouts were sprayed with para-oxon, although the cabbage aphids suffered a high initial mortality, the survivors multiplied unchecked and produced within a fortnight an outbreak of record size. By contrast, on plants sprayed with schradan, a systemic insecticide which enters the plant's sap and kills sucking insects such as aphids but not their enemies, the aphid numbers remained small. To illustrate the breeding potential of aphids, it has been calculated that one female cabbage aphid, if able to breed unchecked for a season, could give rise to half a trillion individuals, weighing 250 million tons!

Man-made pests

There are also many examples of "man-made pests", that is, insects or mites getting to pest status following the application of insecticides for the control of an existing pest, the insecticides having little or no effect upon them but killing their natural enemies. The best known in this country is that of the fruit tree red spider mite which, prior to 1922, was almost unknown as an orchard pest. Populations increased after the widespread adoption of tar oil winter washes for the control of the eggs of aphids and apple sucker; while not toxic to the red spider eggs, these washes killed the predators which overwintered among lichens on the trees. The replacement of winter washes by sprays in spring of BHC and DDT has had a similar effect. Increases in numbers of this and other species of red spider mites, particularly after the use of DDT or parathion on fruit trees and bushes, have been reported from many parts of the world.

A third undesirable effect concerns the development of strains of insects and mites resistant to certain insecticides. Over twenty of the world's pests have developed resistance of this kind, and the risk of this happening must be increased if a chemical kills the natural enemies of a pest, so that the resistant strain has a chance of surviving and becoming prevalent.

Until more positive ways are found of achieving control of pests by biological methods, and more specific and selective insecticides are discovered, our approach must be the rather negative one of avoiding, as far as we can, the destruction of useful insects, and there are several ways of at least minimizing undesirable effects of insecticides. Apart from the unknown risks of causing insects at present unnoticed to become pests, it is apparent from what has been said that this is especially important with aphids and mites, and some care is necessary in the choice and use of an insecticide.

Aphid and crop

Most aphid pests alternate between summer and winter host plants, and on their summer host crops produce a succession of generations with migratory forms which disperse to other crops. Consequently they can keep ahead of their enemies and it is unlikely that predators and parasites by themselves could always keep them sufficiently under control, especially in seasons such as the warm, dry summer of 1959 which favour a high breeding rate. This means in general that, to give best results, an insecticide must be very efficient and persistent, or one that will spare the natural enemies so that they can keep survivors in check. Much depends on the aphid and the crop concerned. For example, on broad or field beans which are colonized for a relatively short time by the black bean aphid, a persistent systemic or partially systemic insecticide (such as demeton-methyl, "Rogor" or malathion) properly timed (i.e., applied in June at a time when immigration of aphids from spindle is largely completed) can give satisfactory control, even though beneficial insects are killed. On the other hand, gamma-BHC or DDT, although reasonably good contact aphicides, have little or no systemic properties enabling them to reach aphids hidden among young leaves and do not give good control. Because they are lethal to predators and parasites, they may even result in heavier aphid infestations developing than if the crop had been left unsprayed.

Where aphids are on a crop for a relatively long time, and the crop is liable to fresh colonization during dispersal periods, such as with bean aphid on beet and mangolds or cabbage aphid on brassicas, choice of insecticide is particularly important. In many years the combined effects of the various predators and parasites must help considerably in keeping down aphid numbers, and any disturbance of the balance may lead to unnecessary trouble. Systemics such as demeton-methyl and "Rogor" can effect good reductions in aphid numbers, but these kill many of the natural enemies, and repeated applications may be necessary in seasons such as 1959. The evidence suggests that the selective systemic schradan would give more satisfactory results, and it is unfortunate that this is more costly and poisonous than the others mentioned. It may be found feasible to use a lower dosage rate than that normally employed, which would enable a small and economically unimportant residue of aphids to survive, sufficient to prevent the

predators and parasites from dying through starvation. More research is required before a satisfactory answer to this problem is found, a difficult one in intensively cultivated areas where widespread spraying and shortage of safe alternative host supplies for the natural enemies must mean that their numbers in the area become seriously depleted.

Soil insecticides

Another section of agricultural practice in which care is desirable is the use of soil insecticides. There is evidence that the persistent chlorinated hydrocarbons (such as DDT, aldrin and BHC) can effect marked changes in the soil fauna, and long-term results of these remain to be seen. It has been shown that up to nearly 90 per cent (sometimes more) of the eggs of cabbage root fly may be destroyed by predatory rove beetles, and as much as 65 per cent of the pupae by rove beetles (*Aleochara*) and a parasitic cynipid wasp; and further that it is possible to have levels of insecticide in the soil insufficient to affect the cabbage root fly larvae but which kills some of the predators, thereby resulting in heavier infestations of the pest than would occur naturally. A survey showed that in 1957 some 45 per cent of the potato fields in south-eastern England were treated with aldrin as a routine insurance against wireworm damage. It is unfortunate that risks of wireworm attack cannot be forecast reliably, as this insurance use of aldrin might well lead in subsequent years to more severe attacks by cabbage root fly, and perhaps other pests, as insecticide levels in the soil fall to critical points. Sub-lethal dosages of aldrin might also increase the risk of selection of aldrin-resistant cabbage root flies.

Wherever possible the use of insecticide in the soil should be reduced to a minimum; for example, by using seed dressings where they are effective, rather than mixing insecticide with the soil or applying it as a surface dressing. Seed dressings based on gamma-BHC and other insecticides are usually adequate for the control of flea beetles and cabbage root fly in brassica seedbeds, and for protection of cereals against wireworm attack; also dieldrin seed dressings will control bean seed fly attacking runner and French beans. Planted-out brassicas can be safeguarded against cabbage root fly attack by dipping the roots or by spot drenches of aldrin or dieldrin, which localize and keep to a minimum the amount of insecticide used.

In orchards

In fruit growing, control of apple pests such as aphids (except perhaps woolly aphid), caterpillars, sawfly and codling moth is likely to depend upon the use of insecticides, and the attention of those interested in biological control is directed chiefly to red spider mites. As already explained, the fruit tree red spider mite has become a major pest through destruction of its natural enemies; it has also developed strains resistant to the "summer ovicides" (chlorfenson, etc.) which in the early years of their use gave satisfactory control, and there are suggestions that strains resistant to demeton-methyl are occurring in some orchards.

In the unsprayed apple orchard, red spider is present in very small numbers and it does not multiply to pest proportions. A high percentage of

its winter eggs are sucked by predators, particularly anthocorid bugs and ladybirds, which are active in autumn and early spring and sometimes in the winter. When the surviving eggs begin to hatch in April the mite is assailed by these same predators, and the following generations through the summer by later broods of anthocorids and ladybirds, besides numerous species of capsid bugs hatching from eggs on the trees in spring and early summer, and predatory typhlodromid mites. Competition is continuous and fierce, and red spider mites are held at a steady low level.

By contrast, in sprayed orchards, with many of its predators destroyed on the trees by winter washes or insecticides such as DDT and BHC in the spring, it can multiply freely. Some of the capsid bugs hatching in May and June from eggs on the trees may escape death, and their numbers may be reinforced later in the summer by capsid bugs and second generation anthocorids, rove beetles and ladybirds entering the orchard from wild plants outside. These predators may reduce red spider infestations, and form the basis of a higher and still more effective predator population the following season. If consequently the red spider numbers are reduced to a low level, some of the predators may desert the orchard for richer feeding grounds. Thus violent fluctuations in red spider populations, difficult to predict, are liable to occur. If DDT is used in summer for codling moth control, predatory insects must virtually be eliminated. Sulphur fungicides, particularly lime sulphur, destroy the predatory mites which are potentially of some importance, as they appear to be capable of holding red spider infestations, provided the ratio of pest to predator is not too high.

It will be difficult to modify the orchard spray programme in this country in favour of the predators until a satisfactory way is found of controlling codling and tortrix moths without the use of non-specific insecticides, and of combating apple mildew with fungicides which do not kill the predatory mites. In the meantime some reduction in the use of insecticide could perhaps be made, for there are too many routine sprays of DDT and BHC directed against aphids, apple sucker and caterpillars often not present in sufficient numbers to be of economic importance. Pests such as apple sucker, apple blossom weevil, winter moth (except perhaps in wooded areas) and apple capsid could not stage a serious come-back in a season if a routine spray were omitted. The use of corrugated paper traps for codling moth larvae has been adopted with some promise in one fruit-growing area. The apparently unsatisfactory performance of lead arsenate which, being a stomach poison only is relatively selective, needs investigation.

Finally, in this brief survey of useful insects we must not forget the hive bees and many kinds of wild bees and wasps, and various other species of flies, beetles, moths and other insects which visit flowers for pollen and nectar. These play an important, and in some cases indispensable, part in the pollination of our flower and food crops. In recent years the commercial orchard in blossom has seemed a lifeless world, the only insects visiting the flowers being hive bees in the few spells of sufficiently fine weather. It is easy to understand the fears of those who wonder if ten to fifteen years of spraying with persistent insecticides have reduced the numbers of the many kinds of flower-loving insects, as well as those of predators and parasites. If this is so the effect might not be confined to the orchard itself, for large blocks of sprayed trees could act as traps which would tend

to drain the surrounding area. In highly cultivated districts the widespread use of insecticide on agricultural crops as well would contribute to the drain. Removal of hedges in the name of hygiene, especially those containing sallow whose early catkins attract anthocorid bugs and nurture the wild bees preparing to found colonies when pollen is scarce, and the widespread use of herbicides on roadsides as well as farm land depressing an already restricted flora, must all have a discouraging effect on insects which help mankind. Needless to say, open blossoms should never be treated with chemicals poisonous to bees.

Contract Farming in the U.S.A.

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A booklet with the title *Contract Farming and Vertical Integration in Agriculture* has recently been issued by the U.S. Department of Agriculture. Its findings and conclusions are very relevant to developments in our own farming industry.

MANY innovations of American origin have become absorbed in the British way of life since 1939. In agriculture it is noticeable how the concentration of American effort on achieving maximum output per man is now being paralleled by the British farmer. We are superimposing these concepts upon systems where traditionally land has always been scarcer than labour.

With the developments of improved technology and efficiency have come new marketing situations. The need for consistency in volume and quality of farm products has been highlighted by the introduction of that typically American feature, the supermarket. These multi-line stores, with their self-service and high turnover of goods, have already had repercussions on the food-producing industries. Volume production of high quality goods (many of them prepacked) is being demanded, and there is every reason to believe that this trend will continue.

Farmers, merchants and wholesalers are concerned in this social revolution, and the need for them to work together closely to secure uniform products has already made itself apparent in the United Kingdom.

Vertical integration

Vertical integration implies the sharing of a farmer's managerial decisions and risks in production and marketing with one or more related businesses—for example, the supplier, processor or distributor. Now the big question is whether the American farmer can continue to hold the reins of agricultural production with such active participation by people outside the farm gate.

In a foreword to the bulletin issued by the U.S. Department of Agriculture,

Mr. Ezra Taft Benson, the American Secretary of Agriculture, advises farmers to watch their position before committing themselves too deeply without commensurate rewards. Contract farming would be less necessary if production and marketing were improved. He lays emphasis upon the great value of farmer co-operatives, which he regards as the soundest form of integration for the benefit of agriculture.

The direct cause of the nation-wide turn in the U.S.A. towards integrated production is the much increased size of consumer markets. This has in turn meant radical changes in the way farm products are grown and sold. Retailers and particularly grocers have trebled their volume of business since 1939 and now demand supplies in large quantities and of consistent quality. Co-ordinated bulk buying has resulted.

To meet the demand of retailers and wholesalers, the processors have had to raise their sights accordingly. They now use contracting methods to secure adequate farm supplies of specified quality. Such methods have also resulted in lower unit costs by utilizing plant and labour capacity more fully. As in the case of processors, feed suppliers are anxious to spread their activities over periods long enough to achieve continuous flow and low unit costs.

American farmers and integration

Farmers themselves become party to integration arrangements to secure definite prices, to shift managerial responsibility, or even to obtain capital. Frequently technical guidance is also provided, and this has had a direct effect upon production costs. Quality control in the enterprises concerned has favoured standardization.

In some products, for example broiler integration, considerable expansion has resulted. This is not always desirable. One of the chief consequences of the contract farming concept is to cause farmers to specialize and at the same time, by competition with other less progressive operators, to see an increase in the average size of holding. For instance, 90 per cent of the U.S. broiler production is from farms each producing 40,000 birds a year.

It is clear from the report that contracting for specific crops and types of livestock has gone much further in the United States than in Britain. The stage has been reached when the farmer's bargaining position is often between competing contracting firms rather than in the open market. In some cases, especially in the short term, benefits may accrue from vertical integration, but clearly the farmer's position has become far less secure. The rapid advance of technology which has given rise to specialization in agriculture and business alike is making big demands on the American farmer. The need for well-graded produce and careful timing in marketing becomes imperative to the independent producer. This in turn will mean a bigger demand for research and education.

Co-operatives

A further alternative is, of course, the co-operative organization. In the United States farmers are being advised to strengthen their co-operatives, which it is suggested should aim at better services, stronger financial resources and expansion of interests to embrace more vertical integration.

The degree to which integrated production has affected individual crops and livestock types is of interest. The most firmly established examples of contract farming in U.S.A. are in the fruit and tree nut industries. The citrus areas of California and elsewhere provide outstanding examples of complete processing and marketing services up to wholesale and retail levels by growers' co-operatives. Sunkist Growers Inc. of California, for instance, is a federated co-operative in which many local co-operatives are represented. Picking and packing of fruit is handled by specially trained teams; research, sales and inspecting staffs are available to members. Co-operatives are less well developed in Florida, while in Hawaii the pineapple processors control production, owning and leasing land which is operated by union labour. In the clingstone peach orchards of California, processors are financing fruit growers who exclusively supply them with their produce.

Effect of integration on commodities

About 90 per cent of the canning and freezing vegetables, and half the fresh vegetables and melons, are today supplied by integrated operations in the U.S.A. The so-called "grower-shipper" is the chief agent in dealing with the fresh product and he combines growing, packing and selling. The potato market is one in which the grower-shipper is involved to the tune of 35–40 per cent of the crop. Co-operatives, on the other hand, appear to be lagging behind the commercial interests and account for only 10 per cent of the total volume of the potato crop. The American potato industry is operating against a slowly contracting demand, and with it increasingly high standards are demanded. In Britain there are indications that this situation has started to develop and its lesson is obvious.

As in Britain, sugar beet growing started and has continued as an almost completely integrated industry. Cane sugar, however, shows a varying degree of processor control, this being greatest in Hawaii and least in Puerto Rico and Louisiana. Substantial proportions of the bean and pea crops are produced on contract. With varying degrees of control by processors or co-operatives, the dried product is subject to high quality standards, and integration has enabled complex electronic plant to be used at cleaning stations. It is interesting to note that American importations of high standard dried peas have added to the embarrassment of British growers this season. In cotton growing the degree of complete integration appears to be rather less than in other enterprises. Production credit has, however, long been a feature of this crop, and in most cases ginners and oilseed processors have supplied such credit. Co-operatives currently handle up to 25 per cent of the crop in the major areas, especially in the newer cotton belt of California, New Mexico, Arizona and western Texas.

As in Britain, seed growing—attracting a premium return—is often a contract undertaking. Federal and State regulations are strict, and, in the case of vegetables, seed companies have statutory responsibilities for standards. Hybrid maize seed production is also largely controlled by the seed firms, who may require the grower to do little more than drill the seed which they have supplied. They will arrange for de-tasselling (removing male flowers), harvest, and pay for maize seed which meets the required standards. Beyond the farm gate the handling of maize seed is almost completely integrated.

Though trends towards vertical integration are noticeable, less than 10 per cent of the total output of grass and clover seeds is grown under contract.

Dairying and poultry

The pattern of the American dairy industry is complex by current British standards. Contracts between producers of liquid milk and the retailers and wholesalers are common. Dairy co-operatives take a substantial part in these contracts. New ideas to further integration include producer credit by processors for dairy equipment, and in Utah, Iowa and elsewhere centralized "cow pools". Here animals from several farms are housed, fed and milked, and the milk marketed for a charge which covers all costs.

It is in table poultry that the best-known vertical integration processes are to be found. Originally concentrated in the small state of Delaware, broiler areas have spread extensively in the north-east and the south, with substantial developments on the Pacific coast. It is this very industry which has come to Britain and has already secured a place in the farming fabric. In the U.S.A. the industry is in two segments. Firstly, the contractor supplying the grower with chicks, feed, medicine, fuel and litter, the grower furnishing the housing, equipment and labour. The contractor absorbs any loss but participates in profits. The second segment is that of the processing and distribution, and the two segments deal with one another at a public auction. The risks of production have been responsible for these developments, and as a part of many contracts guarantees are made by the contractor to the grower. These guarantees are sometimes accompanied by bonuses for efficient food conversion or include other output incentives.

The integration of the broiler industry is still developing. In turkey production and in hen eggs, too, integration is increasing, though it is less well developed for eggs.

"Beef factories"

Traditionally, ranch-raised stores from the West were taken to the maize belt of the Middle West for fattening. The present trend—resulting from smaller profit margins, is towards huge "feed lots" numbering from 1,000 to 30,000 head of cattle at a time. These are found not only in the Middle West, but increasingly in the Pacific coast states. This form of integration is sometimes controlled by the farmer and sometimes by chain stores or packing interests, and charges are made on a "per head per day" basis. A similar system has developed in respect of lambs, both in California and the Middle West.

Pigs raised on contract represent only a small fraction of the total numbers.

One form of contract pig farming closely resembles the broiler industry. In this, the pigs, their feed, specialized management and veterinary expenses are supplied by the integrator—who is often the feedingstuffs merchant. The pigs are then marketed by the integrator, and the farmer is paid the equivalent of 1½*d*. a lb for the weight increase. Other forms of contract include the lease of sows to the farmer, with various arrangements for control and management. Pig "hatcheries" have been tried out in some areas over a period of years, but the control of disease and parasites has so far proved to

be difficult. If these difficulties were overcome, integration of the pig industry would rapidly increase.

These developments make it clear that farming is undergoing an important change in the United States. Some of the trends are of long standing, but the general picture is one in which agriculture is becoming closely geared to the processing and marketing industries. There is no doubt that it provides a useful hint of what may happen one day in Britain.

Agricultural Development in Malta

A. T. HAESLER, N.D.A.

National Agricultural Advisory Service, Hunts

Mr. Haesler has spent the last three years in Malta, starting an agricultural advisory service there.

SINCE 1956, efforts have been made by the Maltese Government and the Department of Agriculture to improve the lot of the farmer. These efforts have been made after a visit to Malta by a team of experts from the Food and Agriculture Organisation of the United Nations, who recommended that the establishment of an advisory service was a pre-requisite to more profitable production, and what is more important, to raising the standard of living of the farming community.

As a result I was invited to visit Malta to establish a Maltese Advisory Service. At the same time a colleague from the Ministry of Agriculture was invited to reorganize the milk industry, and two experts from the FAO were engaged to investigate and reorganize the marketing of vegetables and carry out research into the control of the germ causing undulant fever.

The advisory service is staffed by technicians from Great Britain at the moment, but will eventually be taken over by young Maltese, who are at present being trained at universities and colleges in England.

In years to come, when these advisers have been working on the various problems of the industry, and provided they get the whole-hearted support of the Administration, the future should be brighter than the past for the hard-working Maltese farmer.

There are four Maltese islands—Malta and Gozo with the two smaller islands of Comino and Cominotto in the channel between them. Cominotto is uninhabited, and only 35 people live on Comino, which has approximately 100 acres of cultivated land.

The group lie in the middle of the Mediterranean, about 1,000 miles east of Gibraltar and a similar distance west of Suez, 60 miles south of Sicily and 180 miles from North Africa. Malta has 42,000 acres of agricultural land in its 95 sq. miles, and Gozo 10,000 acres in its total area of 26 sq. miles.

The climate is ideal as a pleasure resort, but unkind to the agricultural

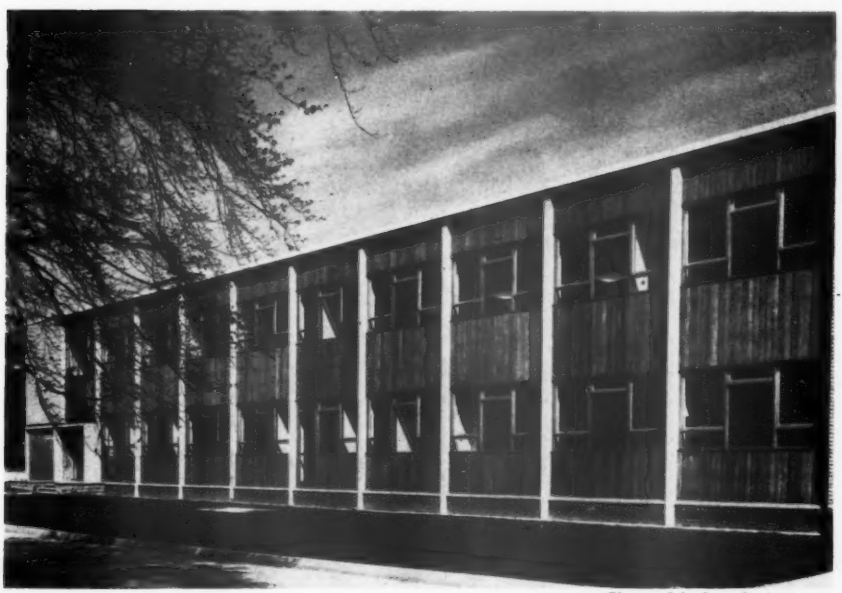
A sheltered valley, showing the small fields, terraced to prevent erosion. The rock face contains old cave dwellings.

Photo: *John Innes Institute*

Bayfordbury House, near Hertford, which with about 370 acres of land has been the home of the John Innes Institute since 1949.

e (Article on p. 253–56)

The modern glasshouses and the new block of laboratories which house the Department of Cell Biology.



Photos: *John Innes Institute*

Dairy Goats (Article on p. 257–60)

Photo: *Smallholder*

A good grading-up goat (British Toggenburg type).

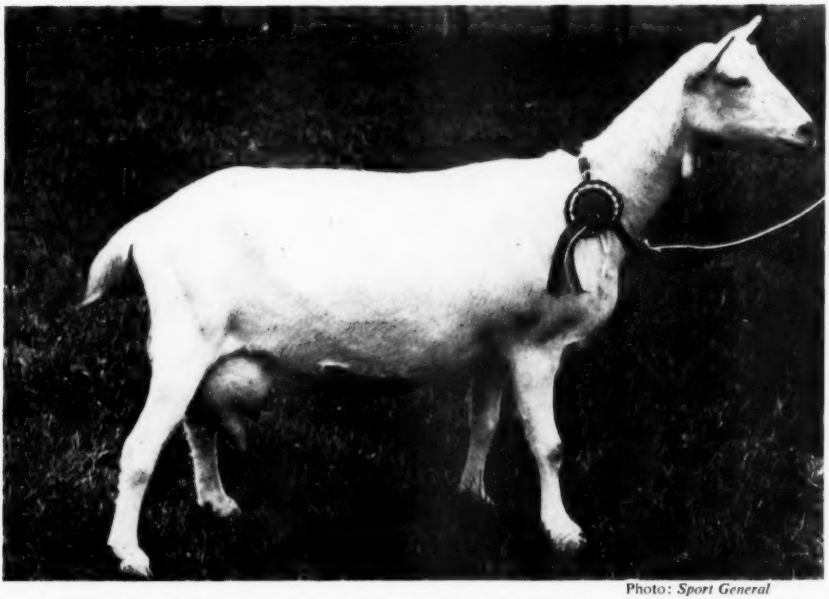


Photo: *Sport General*

A great British Saanen, Champion "Mostyn Mime". Her recorded yield as a first kidder was 4,963 lb in 365 days, at a butterfat percentage of 4·28.

industry in that the summers are hot and dry, and the winters moist and mild. The rainfall varies very considerably from year to year, a dry year yielding as little as 8 inches and a wet winter as much as 30 inches. The rainy season is from October to April.

The sun in the winter is of great benefit, especially now that glasshouses are beginning to be used for the production of tomatoes and flowers. An average of about 5·6 hours of sun per day is recorded throughout the winter months.

Soils

The islands consist of coralline limestone, and the soils overlying the rock differ in texture and composition. There are light, medium loam and heavy soils, all of which are deficient in organic matter.

Of the total agricultural land, 45,000 acres, or 86 per cent, are under cultivation, and 5 per cent of this area is irrigated, from wells which vary considerably in depth. Irrigation water is reserved for crops such as vegetables for local consumption and for early potatoes, some of which are exported to the United Kingdom.

The dry land is devoted to the production of potatoes, tomatoes, onions, melons, pumpkins, cereals and grapes, but since most of these crops are grown during the early spring and summer the winter rainfall is usually adequate to produce a crop. Yields are low, but production could be increased by better management, a more scientific use of fertilizers and better seeds.

The farms are very small compared with farms in this country; of the 12,000 farmers, 4,500 have less than 2 acres, a further 5,500 have between 2 and 6 acres and only 70 have more than 19. It is easy to understand why it is difficult for farmers to make a living for themselves and their families from such limited resources. To augment their income, most of the smaller farmers are part-timers, having another job with the Government, in the dockyard or in private industry.

Maltese farmers, although in the main illiterate, are hard working, pleasant and generous people and usually good husbandmen.

Total agricultural production from crops amounts to about £2m. a year, of which one-third is derived from potatoes. This crop is grown twice a year, and lifted during April–June and October–December. Potatoes and onions are the chief crops for export: in 1959 approximately 11,000 tons of potatoes and 2,000 tons of onions were exported to the United Kingdom. Exports of cut flowers—gladioli, freesias, iris and anemones—are to be increased, and in 1959 the first large-scale production of tomatoes from glasshouses came from the Government farms. Wine and tomato paste production are industries of local importance. Some 3,500 acres of grapes are grown, for sale fresh and for converting into wine. The product is not as refined or mature as are the French or German wines, but is well liked in the islands both for its potency and price—1*s.* a bottle for the majority!

Tomatoes from 2,000 acres are sold as fresh fruit and for making into paste. This paste, with olive oil and bread, is the staple diet of the Maltese workman. Vegetable soup, and pastas such as spaghetti and macaroni, also form part of the diet.

Milk production

Until recent times milk was derived exclusively from the goats and sheep which were taken from door to door and milked in the presence of the customer, but although there are still some 40,000 goats and 20,000 sheep in Malta, the bulk of the milk now comes from the 5,000 cows (mostly Friesians) kept by the 1,277 herdsmen.

As with crops, milk production on individual farms is on a very small scale. One-third of the total herdsmen have only one cow; and one-quarter have two animals, with the result that producing milk is usually a spare time occupation. Dairying in Malta has been very backward in methods of feeding, breeding and production. Buildings are poor and water supplies limited. Bovine tuberculosis and brucellosis have been rampant throughout the islands, but steps have now been taken to eradicate both these diseases. Reactors are slaughtered and replaced by in-calf heifers from Holland.

All milk is bought by the Government, and pasteurized in two processing plants, one in Malta and the other in Gozo. It is necessary to process all the milk, especially goat's milk, which is the source of the undulant fever from which many Maltese have suffered in the past. Economic production is difficult owing to the fact that the cows have to be fed almost exclusively on imported food. Green stuff in the form of barley cut green, prickly pear leaves and arable land weeds are fed during the rainy season.

As much as 6*s*. a gallon has been paid to the farmer for his milk, but in the last year or two the figure has been reduced to 4*s*. 10*d*. This high price, which is based mainly on the cost of food and the cost of the animal itself, can be reduced by the Maltese herdsman adopting a better system of feeding, using balanced food rationed according to yield. Obviously the herdsman cannot be expected to resort overnight to a system of feeding that is quite foreign to him, but it is hoped that in time the advisory work being carried out now will teach him to change.

Pigs and poultry

Pork is the favourite meat of the Maltese; 30–35,000 pigs are required each year to satisfy the market for the fresh article. Unfortunately, little regard is paid to consumer demand, with the result that pigs weighing upwards of 175 lb dressed are commonplace. Until 1958, practically all pigs were of the Large White type, many of which had lost conformation and performance through in-breeding.

An attempt has been made to improve the pure stocks by producing quality pigs at the Government farms for sale to pig farmers. The Wessex Saddleback has been introduced for crossing with the Large White for pork pig production. This breeding policy, together with the adoption of more scientific feeding, will show dividends if properly managed and directed.

To combat swine fever and swine erysipelas the Government has introduced a free vaccination service which is available on request. Demand is only moderate, and not sufficient to prevent outbreaks of these diseases.

There are about 400,000 birds on the islands, producing only a very small part of local egg requirements. This is due to poor stock, bad feeding and bad management. Maltese poultry farmers could easily produce all the eggs

and poultry the population needs, but 15 million eggs and poultry meat to the value of approximately £250,000 have to be imported every year.

To increase efficiency and profitability from poultry, the Department of Agriculture, through its advisory service, has established a breeding flock of Light Sussex hens, which will be used with Rhode Island Red cockerels to produce a sex-linked chick. The pullet chicks will be sold to farmers at a realistic price, and the cockerels will be diverted to broiler production, which is just starting on the island. It is hoped that these methods will make the poultry industry flourish.

Fowl pest is endemic in the islands, and although there is a free vaccination service to prevent the disease, so few poultry are treated that from time to time the disease flares up and wipes out considerable numbers of birds. Compulsory vaccination would not be feasible, since it would need an army of officials to supervise it, and many backyard poultry keepers would avoid it.

Black Currant Leaf Spot and its Control in the West Midlands

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Full results of spraying trials in the West Midlands are not yet available, but already a provisional programme has been worked out for plantations where black currant leaf spot is a present problem.

IN recent years, premature defoliation or partial defoliation has been a common sight in black currant plantations in the West Midlands, especially in Herefordshire and west Worcestershire. Occasionally leaf fall has occurred so early that the fruit has started to shrivel before picking. Whilst drought may have contributed to the early defoliation during 1959, by far the most common cause in black currants is infection by the fungus *Pseudopeziza ribis* Kleb., the cause of leaf spot. This is no new disease but one that has gained prominence in recent years owing to the increased acreages of currants being grown.

Long before the leaves drop off, leaf spot can be seen on the upper surfaces of leaves as scattered dark-brown shiny spots about the size of a pin's head; on the lower leaf surfaces these appear fawn in colour. Individual spots do not increase greatly in size as their extension is limited by the small veins of the leaf. As the disease develops and more infections take place, however, the spots may become so numerous that they coalesce, to cause browning of the whole leaf and finally leaf fall. Stem infection can also occur, but has only rarely been recorded in this country.

Overwintering spores

Throughout the season the spots on the leaves produce conidia or "summer spores", which appear in greyish, mucilaginous masses when the leaves are wet. These spores are carried to neighbouring leaves and bushes by splashes of rain, and possibly also by crawling insects. At the end of the season when infected leaves have fallen to the ground, the ascospore or "winter spore", is produced. These do not mature until the following spring, when they are released and carried by air currents into the bushes on which, under suitable climatic conditions, they start the new season's infection. In England the relatively mild winters permit the overwintering of conidia on fallen leaves, so that these spores are also available to initiate infection in the spring.

When leaf spot attack starts so early that shrivelling of the fruit results, the serious effects of the disease are obvious. When, as is more usual, defoliation occurs after picking but nevertheless prematurely, the effects of the disease are less obvious. It is after harvest, however, that the fruit buds which will produce the next season's crop are formed, and work many years ago at Long Ashton Research Station showed that premature defoliation may result in a loss of as much as 25 per cent of the crop in the year after

attack. With the present high value of the black currant crop, it is clear that control measures are called for.

As with other diseases, it is noticeable that some varieties of currant are less susceptible to leaf spot than others. Unfortunately two of the most popular varieties in the West Midlands, Baldwin and Wellington, are among those most susceptible to the disease. The varieties Mendip Cross, Laxton's Grape and September Black are less susceptible, but in some seasons Mendip Cross, which is also widely grown in the West Midlands, is severely infected. Thus, at present, disease resistance as a method of control is not promising.

It has also been shown at Long Ashton that if vigorous growth is induced in Baldwin by heavy manuring and moderately severe pruning, this variety is less susceptible to leaf spot than when lightly manured and pruned. With susceptible varieties grown in areas where leaf spot is a problem, it is important, therefore, to ensure vigorous growth by suitable manuring and pruning, if the severity of an attack is to be minimized.

Spray control the most promising method

Leaf spot may be controlled by spraying the bushes during the growing season with one of a number of fungicides. If currants are being grown for the retail trade, there is no restriction on either the type of fungicide or the number of applications that may be made; but if the currants are intended for processing, the nature and extent of the fungicidal deposit on the fruit is of great importance. Sulphur-containing sprays cause corrosion and "blowing" of the containers used in the canning process; copper-containing sprays are believed to cause oxidation of vitamin C, and are consequently banned by the producers of black currant syrup. The processors do not concern themselves with the type of fungicide spray used after picking, but in the West Midlands much of the damage due to leaf spot may already have been done by then. At present, the principal producers of black currant juice permit the use before picking of only two types of fungicide, zineb and captan, and these may not be applied within one month of picking.

In 1958, the N.A.A.S., with the co-operation of two Herefordshire growers, began trials in plantations of the variety Baldwin, in which leaf spot had been a problem for a number of years. The object was to determine what number of captan- or zineb-containing sprays applied within the period permitted by the syrup manufacturers would give a commercial control of leaf spot. It was hoped, too, that information would be obtained on the timing of spray applications which would give the greatest benefit from a limited spray schedule. Initially it was estimated that if spraying were commenced towards the end of April—which, in most seasons, is thought to be in advance of ascospore discharge and when the leaves have reached the size of a florin—and were repeated at fourteen-day intervals, a maximum of four or five pre-picking sprays could be given within the "permitted" spray period. It was decided therefore to investigate the control of leaf spot given by a full schedule of all four (or five) pre-picking sprays, compared with the first two pre-picking sprays only, the last two (or three) pre-picking sprays only, and no spray treatment. It was decided later to split some of the plots to measure the effect of a single post-picking spray both separately and added to the full schedule of pre-picking sprays.

First results of spray trials

On the basis of two years' work it is too early to draw any final conclusions from the results and, as the treatments were applied to single plots only, they could not be analysed statistically. In the absence of yield figures for 1958 and 1959 to match with the corresponding records of percentage leaf spot and defoliation, the results cannot yet be evaluated on an economic basis. Subject to these reservations, a few tentative conclusions may be drawn from the results obtained so far. These enable a provisional spray programme to be suggested for plantations where the disease is already a problem. A suitable programme to protect a young plantation from infection, or keep a slightly-infected plantation from becoming seriously infected, has yet to be worked out.

The results for both the 1958 Herefordshire trials and a trial in Worcestershire in 1959 indicate that zineb applied at a strength of 2 lb 75 per cent wettable powder in 100 gallons of water, and at the rate of approximately 200 gallons per acre, gives better control than captan applied at the strength of 1½ lb 50 per cent wettable powder in 100 gallons of water and at the same rate per acre.

In both 1958 and 1959, as might be expected, the best control of leaf spot, as assessed in September, was obtained by a "complete spray programme" consisting of four to five pre-picking sprays of zineb, followed by one post-picking spray. This programme reduced the degree of leaf spot infection, in comparison with the unsprayed control, by between 40 and 60 per cent. In neither season did a single post-picking spray give a significant control. Of the four (or five) pre-picking sprays it is the latter two (or three) that appear to have had the most effect in both seasons, and there is little doubt that when these sprays are followed by a single post-picking spray their value is considerably enhanced.

From these results it may be inferred that if a complete programme is not practicable, a suitable and beneficial alternative would consist of a spray applied in mid-May, followed by another in early or mid-June, and a third immediately after picking. Trials are continuing, and it is hoped that more definite recommendations will emerge in due course.

John Innes Institute

KENNETH S. DODDS, D.Sc., PH.D.
Director

In the fifty years since "John Innes" was founded, the Institute has gained a world-wide reputation in the field of plant research—both pure and applied. Dr. Dodds, its Director since 1954, describes some of the interesting work on which the staff of the Institute is engaged.

THE John Innes Institute began its working life in 1910 on five acres of land adjoining the home of the late Mr. John Innes of Merton, who bequeathed the necessary funds in his will. Some of its objects are "to carry out investigation and research, whether of a scientific or practical nature, into the growth of trees and plants generally". These are wide terms of reference, but they were soon limited in practice by the appointment of William Bateson as the first Director. It was he who directed the early steps of the Institute into the field of genetics, a term which he had invented four years previously. From these early days until the onset of the second world war, the Institute can be said to have enjoyed a unique reputation in its various fields of investigation, which have always included both pure and applied research.

Primary interest in genetics

William Bateson investigated the inheritance of characters by studying their segregation. A perusal of his early reports to the Council of the Institute shows that, from the very first, a wide range of topics was investigated; many of them still find a place in programmes of research. In collaboration with Miss Pellew, he prepared an account of coupling and repulsion in the sweet pea. He also studied the rogue character in garden peas, the inheritance of fruit characters in *Capsicum*, parthogenesis in *Nicotiana* and the sexual characters of fowl. Under his guidance a small but keen band of visiting workers studied, among other problems, heterostyly in *Lythrum*, *Oxalis* and *Linum*, sex expression and inheritance in *Begonia*, the chemistry of pigmentation and the genetics of strawberries, canaries and bees. From the very first a programme of fruit breeding was undertaken. Breeding experiments with potatoes were also carried out on a considerable scale, one of the characters of interest being susceptibility to *Phytophthora* blight. Under Bateson's guidance, all members of staff contributed to a comprehensive survey of variegated plants, experimental material which once again has become fashionable. The genetics of micro-organisms also found a place in the research programme of the Institute, being represented by studies of the inheritance of aversion between mono-spore mycelia of the fungus *Diaporthe perniciosa*, as well as investigations into the life history and sex determination in the mycetozoa.

In Bateson's very first report, the difficulty of raising healthy and vigorous seedling progenies is mentioned. To try to overcome these horticultural problems, the Institute studied methods of soil sterilization, the formula-

tion of composts, propagation from seed and glasshouse climatology. In so doing it gained no less a reputation in horticulture than it enjoyed in genetics. Many of the improvements have passed into standard horticultural practice; indeed, to the man in the street, "John Innes" means "compost"!

It was in 1921, during a visit to the United States of America, that Bateson accepted the chromosome theory of heredity. His acceptance had a profound effect on the development of the Institute because cytology thereby came into its own: W. C. F. Newton was appointed cytologist in 1922 and, two years later, was joined by C. D. Darlington. The study of the mechanism of heredity was added to the study of the laws of heredity.

Bateson died suddenly in 1926; the Institute therefore had enjoyed his wise and strong guidance for sixteen years. The John Innes owes its initial impetus and much of its subsequent development to its first Director.

Sir Daniel Hall followed Bateson and was Director from 1926 to 1939. The period between the wars was the heyday of Mendelian genetics and metaphase cytology, and the Institute was outstandingly productive. By 1926, M. B. Crane was able to summarize his experiments on the pollination of plums, cherries and apples, and to show their bearing on orchard practice. Darlington soon settled down to the series of investigations that was to culminate in *Recent Advances in Cytology* (published in 1932) and, later, *The Evolution of Genetic Systems* (1939). J. B. S. Haldane was tackling problems of mathematical biology and, at this early date, ventured to speculate about the biochemistry of the gene. The Institute was the Mecca of cytologists and geneticists, and many scientific pilgrims made the journey there from foreign parts.

In 1939 Darlington became Director. Like Bateson before him, he laboured under the restrictions of war, which naturally imposed a severe curtailment on research work. After the war, he carried through the onerous task of settling the Institute in its new quarters at Bayfordbury and suffered the interruptions caused by this removal. Darlington was at the John Innes for thirty years before he moved to Oxford in 1953 as Sherardon Professor of Botany.

Move to Bayfordbury

By 1926 the estate at Merton had been expanded to occupy 25 acres. Further expansion became impossible owing to the pressure of suburban housing, and by 1930 both land and buildings were badly overcrowded. When it became possible, at the end of the second world war, to consider a betterment of conditions, there was no alternative but to look for a new home for the Institute. This was found at Bayfordbury in Hertfordshire, 20 miles north of London. The Mansion at Bayfordbury, built between 1759 and 1762, together with park land of about 370 acres, was bought by the Trustees of the John Innes Charity and, with the help of the Ministry of Agriculture, converted for the use of the Institute. The move took place in 1949.

The present departments

From the beginning the work of the John Innes has ranged over a very wide field of inquiry, and the present five research departments continue to enjoy this scientific freedom. Many problems which they have studied seem,

at first glance, to have been divorced from practice; but their solutions have, in reality, supplied information of universal application to plant and animal breeding. Indeed, enough is now known about the general principles of inheritance in our crop plants to provide a sound scientific basis for a programme of improvement. Meanwhile biochemistry has invaded genetics—a trend foreshadowed by the investigations of Haldane and Scott-Moncrieff at the John Innes in the 1920s. Biochemistry seeks to study the chemical links between particular nucleocytoplasmic determinants and the metabolism and organization of the cell; nowadays, the control of enzyme syntheses and the structure and behaviour of macromolecules are of leading interest. For these purposes, micro-organisms are technically favourable, not least because of the refinement of genetical analysis possible in them; the study of the gene is dependent on the adequate screening of large populations in order to detect rare cross-over events and mutations, an approach to which micro-organisms are pre-eminently suited. These trends are reflected in the work of the Institute.

Genetics

Three fungi are being used at the John Innes Institute to provide information about the structure and function of genes and how they change and recombine spontaneously or under the influence of special treatments. In *Neurospora crassa* there are a number of mutants which effect the production of glutamic dehydrogenase. A study of their complementation patterns is not only revealing the structure of the gene but also helping towards the understanding of basic steps in the synthesis of this enzyme. In *Coprinus lagopus* the structure of the multi-allelic loci controlling sexuality is being analysed by the use of linked biochemical markers in recombination experiments. The organism *Ustilago maydis* is being used to study the process of recombination caused by mitotic crossing-over.

Plant breeding

Perhaps the Department of Plant Breeding illustrates more clearly than any other the benefits that are to be derived from a blending of theory with practice. Its programme of fruit breeding was initiated by W. O. Backhouse and continued by M. B. Crane. Their studies on incompatibility in the pollination of fruit trees became a practical guide to the breeding of fruits and also to the laying out of orchards. Nowadays, special attention is being given to the selection of disease-resistant fruits; the diseases under study include scab and mildew of apples, bacterial canker of cherries, red core of strawberries, leaf-mould of tomato and tobacco mosaic of tomato. The possibilities of using induced mutations in the improvement of clonally propagated crops are also being explored. The tomato, which was used by Crane in 1912 for a study of fruiting, still continues to be a favourite plant for genetical experiments. It is being used for studies of heterosis and quantitative inheritance, and attempts are being made to identify the active genetic regions in its chromosomes. Work is also being done on the cytotaxonomy of diploid species of *Fragaria* and on the section *Pimpinellifoliae* of *Rosa*.

Potato genetics

The Department of Potato Genetics was established at the John Innes late in 1955 with the transfer from Cambridge of the Commonwealth Potato Collection. This Collection, which has been accumulated over the years from 1939, provides material for the study of variation in *Solanum* and a reservoir of hereditary characters for breeding. Nearly 1,000 lines, representing 50 wild species and hundreds of cultigens, are maintained. The material is being used for cytogenetical, biochemical and evolutionary studies as well as for investigations of the genetics of disease reaction. It is also providing information about the methodology of potato breeding.

Physiology and plant culture

The Department of Physiology and Plant Culture is interested mainly in the analysis of factors affecting the early growth and development of the tomato. Two sets of growth rooms, which have been built and developed experimentally as a separate departmental project, are being used to give highly controlled conditions of light, temperature and humidity. They provide the controlled environments under which tomatoes can be raised for measurements of the effect of light intensity and temperature on the rates of differentiation of leaves and flowers. Growth rates are being measured from the primordial stage onwards in terms of dry weight and cell multiplication. The results obtained in the growth rooms are being related to growth and development in the glasshouse, with the object of gaining a better understanding of the effects of variation in natural light intensity in relation to practical cultivation.

Cell biology

The emphasis in cytology has shifted in the last few years from the genetical to the physiological, from heredity itself to its biochemical basis. Considerable progress in this direction has been made in the last few years, particularly since desoxyribose nucleic acid (DNA) came to be recognized as the most likely carrier of genetic information. One of the main themes of work in the Department of Cell Biology is the study of large molecules such as those of DNA. Facilities for the biochemical investigation of cell components and processes have been provided in the form of a new and excellently equipped block of modern laboratories. Techniques that combine chemical and autoradiographic procedures have been developed to measure nucleic acid turnover in different parts of the cell. Such procedures are enabling the relationship between nuclear and cytoplasmic ribonucleic acid to be examined in detail in both animal and plant cells. We believe that by the use of this material and by these new methods further insight into old and familiar problems will be gained.

Dairy Goats

JOAN SHIELDS
Axminster, Devon

The highest 365-day yield by a goat is 6,661 lb, and the highest life-time yield 36,884 lb—quite a lot of milk for an animal weighing only 130–190 lb.

IT has taken two world wars to make the public conscious of the dairy goat. For many people, the goat was just a scraggy, horned hank of long unsavoury hair, tied by the neck to a sparse hedge, and owned by some fanatic who could apparently drink the stuff she gave without being asphyxiated.

Probably few pedigree dairy goat herds have become established simply through their owners wishing to make money, although undoubtedly this is possible. A crying need for milk in rural areas, a love of animals, and the satisfaction of one's own produce have often been followed by requests for the odd pint or two, for some special case. The herd is increased, the milk round grows, and the owner is fired with ambition to breed the perfect goat. After his first agricultural show, and having been well and truly bitten by the show bug, he continues to turn out at all the major shows with unfailing regularity, until well nigh bath chair-borne.

Official milk-recording, undertaken by National Milk Records, adds further zest to the pursuit, and soon he finds orders for pedigree goats which have done well coming from all over the world.

Among his customers are those babies who cannot take any product of the cow without breaking out in the appalling itching sores of infantile eczema, making life a nightmare for the parents too, for they of course are kept awake at night. These infants may not respond to a goat's milk diet for some weeks, but they gradually become very much better, and eventually are completely cured. Cured, at least, until some kindly soul forgets about the beef allergy, and hands out a sweet, or an ice-cream, containing cow's milk. The diet must be strictly observed—butter and, later, cheese, etc., all being the product of the dairy goat—until the child is of an age to have overcome his allergy.

Other people come for milk, and without keeping an absurdly large herd over the winter months the owner is often hard put to it to keep up a steady output, for goats have a specific breeding season, mating during the months of September to February, and kidding in early spring and summer.

This difficulty is overcome by length of lactation. The pedigree goat's ability to milk consistently for two or three years without kidding enables the owner to leave half his herd unmated—to have every other year kiddings, in fact. These "run-through" goats give about half their peak yield during the worst months, increasing to about two-thirds of their former peak yield with the spring growth. After mating in autumn, they continue to milk until about eight weeks before kidding. It is not unknown for such a goat to give more milk during the second spring and summer of her extended lactation.

The dairy goat farmer must grow everything he possibly can, so that only

the last half of his milker's production ration is bought concentrates, if his farming is to pay. The plough is taken round the farm, and kales, roots, seeds leys, lucerne, oats and tares, and maize are all grown in rotation. The hay crop in particular is of the utmost importance, the ideal being to have some clover or lucerne, and some very sweet old herby pasture hay as a change.

Management

Concentrates are fed at about the same rates for production as to cattle, except that the very high yielder can seldom take in as much. A two-gallon goat would be likely to stick at about 5 lb, and this would probably be given in the form of mixtures balanced especially to her liking. Individual attention, as in all forms of stock, means much.

Clean, warm drinking water helps to keep up the yield, for it is found that a goat will drink more if the chill is off. Minerals are of great importance, and if the yield is over $1\frac{1}{2}$ gallons daily, more than an ordinary salt lick brick may be needed. Goats suffer from much the same deficiencies as sheep, and it pays to study the land, and remedy any known shortages, such as cobalt, iodine, etc.

Commonsense management, routine worming, and plenty of exercise, bulk foods in plenty, and not too much from the miller, are the essentials. Although the goat responds very well to the conditions outlined, one must never lose sight of the fact that she was intended by nature to thrive where no cow could do so. Thus moorland, mountain, woodland, and scrub make excellent goat-browsing, and if her yield is not so high, she will certainly remain extremely healthy.

Goats are quick and easy to milk, and so are usually hand-milked, but the larger herds are of course machine-milked. The dairy routine is much the same as with cow products, but because the goat is extremely clean, it is much easier to get a really good clean sample of milk. In the bad old days, much prejudice was built up because some careless people allowed their male goat to run with their milkers, with the result that the females were tainted with his shocking smell, and also the milk. I can't think of anything worse.

The milk and milk products

As the fat globules of goat's milk are very small (although butterfat content is much the same as in cow's milk, on average), the cream does not rise very readily; consequently a separator is used if much cream is to be dealt with. Colouring matter is added to cream for butter-making, for the product would otherwise look rather like lard. Butter from dairy goat's milk has more than once won the highest award, in open competition with cow butter.

Scalded or Devon cream may be made, but I prefer cream which has been separated and refloated upon a small quantity of skim milk for heating.

Of the cheeses, the soft cream or Coulommier types lend themselves well to manufacture with goat's milk. Many of the Continental types are in fact made with goat's milk, or part goat and part ewe milk in France. The secret of success lies in having the room temperature and draught right, and, as with all dairy products, in good hygiene.

In Britain there has never been a steady demand for goat's flesh, but most breeders eat their surplus male kids, and those living near ports find that foreigners ask for goat's meat. Talking of ports reminds me that I recently heard that one breeder is regularly supplying milk for the "Queens", and another for the ships going to Africa.

I have always felt that there should be a market for skins, particularly Anglo-Nubian kid skins, which are really attractive—especially the brightly-coloured spotted ones. Some enthusiasts do make fur-backed gloves, slippers, and hand-bags, but there seems to be no organization dealing with skins.

The export market is of very real and growing importance, for this country has a great reputation to keep up, and we have the best dairy goats in the world. The knowledge that there may be a profitable sale abroad for well-bred, well-reared stock with show wins and milk records behind them, is an added incentive to breed from only the best. There may have been higher prices paid, but I know of one young male goat which fetched £180 ex farm. The average is probably around £50 for young adults. A good commercial type, not up to show standard, but with good conformation and a yield of around 2,500 lb, would cost something in the region of £25, and a young kid from a good herd, about 10 guineas.

The household goat owner who has only two or three need not concern himself over the unpleasantness of keeping a male, for the British Goat Society issues a sixpenny list of all males at stud, some of which are "mobile". Stud fees, compared with those for other livestock, are low; two or three guineas buys the service of the best. The male, incidentally, only wears his fearsome smell during the rutting season, and often is a very charming fellow, as far as character goes.

A breed for every need

As with cattle, there is a breed for every need. Temperament differs almost as widely as type, and it is easy to advise the beginner on his choice, for stall-feeding, for free-range grazing off good land, or for exposed hill country.

To tell him which breed gives the most milk, a perennial question, is not so easy, for it is the strain within the breed and the eventual management of the animals which counts. There are six distinct breeds, each having a section of the British Goat Society's Herd Book. These are the two imported from Switzerland, the Toggenburg and the Saanen, for both of which the herd book section is "closed"; that is to say, no grading up is permissible, and all are direct descendants of the original imports. The British Saanen and the British Toggenburg, both having the imports as a background, have been mated back to pure blood in several instances, but have other breeds or indigenous blood in their past.

The British Alpine, a made breed with, unfortunately, no recourse to any pure stock, is at her best an outstanding looking animal and often an excellent performer, but very difficult to breed.

The Anglo-Nubian is so completely different from all the rest, with her Roman nose and long lop ears, that I once heard her described as looking like a grey flannel camel! Not that grey is her normal colour, for she comes in all colours. This goat is an individualist, her voice is high and often mournful in the extreme, her devotion almost spaniel-like, and her butterfat

content higher than any other breeds. A tendency to go dry soon after mating is being overcome by careful breeding.

The seventh section of the Herd Book contains all goats having a pedigree, but by virtue (or otherwise!) of their cross-breeding not fitting into a breed section. The British section is also the "jumping off" rung of the ladder for graded-up goats. Perhaps on account of hybrid vigour, this section often contains record-breaking milkers.

There is also an identification register, for goats which cannot be entered elsewhere but will be shown; and a supplementary register and foundation book, these last two being the bottom rungs of the grading-up ladder.

The British Saanen keeps up her top registration figures, understandably, for she is a worthy, reliable milker, will graze well, and yet take kindly to stall-feeding. These remarks also apply to the smaller pure Saanen, although there are fewer of them. White goats are not everyone's choice, and they certainly don't look good unless they are really spotless.

The Toggenburg and British Toggenburg, both shades of brown and fawn, with white markings known as "Swiss", are shapely, adaptable and intelligent, particularly the pure Toggenburg. Her yield is not so high, and her butterfats when in full milk tend to be lower than her bigger relation's, but she is extremely hardy, has a thicker and sometimes longer coat, with attractive pale fringes. She is the ideal breed for moorland country, and will stand much worse weather than the shorter-coated breeds. Length of lactation is good, for although she may never rise above 10 lb daily, she seldom falls below 6 lb, come rain or snow.

The black and white British Alpine is an excellent browser, but does not care for wet weather, and makes something of a fuss over flies in hot summers. Her coat is extremely fine and silky; her yield is good, and so are her butterfats. Temperamentally she is rather prone to wander over and see what is on the other side of the fence, if given the chance.

Farming Cameo: Series 2

28. East Lancashire

R. WALSH, B.Sc.
District Advisory Officer

A HUNDRED tall factory chimneys to be seen from any one of a dozen hills in the area, an urban population of two million, and almost half the holdings less than 20 acres: these are some of the features which make East Lancashire an unusual farming region. The area extends in a 15-mile wide strip almost 40 miles along the western slopes of the Pennines, from Pendle Hill, standing sentinel in the north over the road from Yorkshire, to the urban sprawl of Manchester in the south. To the visitor the dominant aspect is of industrial towns joined one to the other, but a few miles into the hills are dairy farms where the view of grazing cows against the industrial backcloth has its own peculiar beauty.

The district ranges in altitude from 150 feet in the south west, where it borders the intensive arable holdings of Chat Moss, to over 1,000 feet in the heart of the Pennines. In general the soil types follow the contour, on the lower-lying ground being derived from glacial drift and on the higher land from Millstone Grit. The glacial soils are reasonably fertile, and when well farmed can produce good crops; the gritstone soils become poorer as altitude increases, and on the steeper slopes can be very thin and acid.

East Lancashire is noted for its humid atmosphere; with an average rainfall of forty-five inches spread fairly evenly throughout the year, this is not surprising. Even this, however, has its advantages for grass growth when one recalls parched summer grazings in drier areas.

Winters are relatively mild, but rain-soaked ground is slow to warm up in the spring and early grazing is difficult. Fortunately, autumn usually provides a spell of good weather, and late grazing helps to shorten the winter.

Dairy farming is the main enterprise, with pigs and poultry as sidelines. With its market close at hand, the area is traditionally the home of the producer-retailer. Up to 1939 the farming system was based on heavy stocking with a flying herd, purchased feed, and permanent grass used only for grazing and hay. The war, with its shortages of imported feed, did much to alter this, but old methods and traditions die hard and even today milk production is still heavily dependent on "proven", as it is called locally.

The flying herd in its true sense has largely gone, but with small farms and the economic necessity for heavy stocking, self-contained herds are found only on the bigger farms. Most farmers do manage to rear a few heifers, however, and the coming of complete attestation has encouraged the trend away from the regular purchase of new calved cows.

East Lancashire is one of the few remaining strongholds of the producer-retailer system, but with small farms limited as to expansion and type of output, it is not surprising that the farmer takes advantage of any oppor-

tunity to increase his income, and perpetuates a system looked upon by the purist as non-agricultural.

Grassland management is not particularly good. Permanent grass forms most of the acreage, but on many farms it is customary to plough a small acreage of kale each year and follow it with reseeding. Many farmers rely on farmyard manure and lime, with occasional dressings of slag; but when fertilizers are adequately used they give heavy crops of grass ideal for grazing or silage. Arable crops other than kale play very little part in the economy of the farming, except on the lower-lying farms of the south-west corner of the area, where potatoes and cereals provide a very useful addition to the income from milk.

On the majority of farms the only subsidiary enterprises are poultry and pigs. Poultry are a very useful source of farm income; pigs, on the other hand, come and go on the farms of East Lancashire with every alteration of pig prices. One system of pig farming in the area is worthy of note, however. Advantage has been taken of the wasteful habits of the urban population to swill-feed pigs on a factory scale, and the area immediately round Manchester has probably the highest concentration of pigs in the country.

There is scope for sheep on most farms, and the benefits of their grazing would be very much welcomed, but with the number of dogs in the area sheep farming is confined to the hills, where smoke-blackened Lonk and Derbyshire Gritstone flocks can be seen on the *Nardus* and *Molinia* rough grazings.

Smoke pollution is a constant menace in the district, increasing the lime needs of a naturally acid soil, limiting to an obvious but unknown extent the output of grass, and attacking the metal of machines, buildings and fences. Much damage is done by trespass to walls, fences, and growing crops, and, unfortunately, there is often ill feeling between the farmer and his urban neighbours, aggravated in many cases by the constant loss of land to new housing estates, which in turn increase the trespass.

The chief problems in the area are those of small farms and lack of capital, the two things being very much inter-related; without capital, bigger enterprises are not possible, and small units do not give scope for increasing capital. The typical farm of the area is often of 35 acres, with 16 cows, 3 or 4 young stock, 150–200 laying hens and a couple of breeding sows, which obviously gives very little opportunity for putting money back into the farm, only providing, in fact, a living with very little return for management and interest on capital. The only way that income can be increased is by intensive stocking, the use of fertilizers and silage to cut the feed bill, and increases in subsidiary enterprises. This has, in fact, been done on many farms with good results.

At first sight East Lancashire might be thought a not very pleasant area to work in. To a countryman the sight of factories and busy streets can be depressing, but there is pleasure in well-grown grass and high-yielding cows achieved despite the battle with pollution, trespass, rainfall and difficult terrain. The area's problems are varied and challenging, but there is reward in the friendliness of warm-hearted, if sometimes outspoken, farming folk.

THE MINISTRY'S PUBLICATIONS

Since the list published in the July 1960 number of AGRICULTURE (p. 211) the following publications have been issued.

MAJOR PUBLICATIONS

Copies are obtainable from Government Bookshops or through any bookseller at the price quoted.

Farm Buildings Pocketbook (*New*) 2*s.* 0*d.* (by post 2*s.* 4*d.*)

A useful handbook containing a multitude of facts and figures about accommodation requirements, dimensions and standards in farm buildings. It is divided into sections dealing with machinery, stock, storage, electricity and drainage.

BULLETINS

No. 142. Sugar Beet Diseases (*Revised*) 7*s.* 6*d.* (by post 7*s.* 11*d.*)

Information gained from extensive research both in the field and laboratory over the last 10 years is summarized in this new edition. Valuable additions have been made in the study of virus yellows and its control, and new information included on the control of seedling leaf and vascular diseases, chemical and insect injury, genetical abnormalities and root diseases.

No. 153. Sugar Beet Cultivation (*Revised*) 8*s.* 0*d.* (by post 8*s.* 6*d.*)

This new edition has been completely revised. Special attention has been given to advice on manuring, the advantages of down-the-row thinning compared with cross-blocking, and the chemical control of weeds. There is a new chapter on the economics of sugar beet growing.

No. 166. Sheep Breeding and Management (*Revised*) 6*s.* 0*d.* (by post 6*s.* 6*d.*)

Deals with marketing, breeding, nutrition and the general management of mountain, hill and lowland flocks. There are also sections on equipment and the causes and prevention of losses.

LEAFLETS

ADVISORY LEAFLETS

Up to six single copies of Advisory Leaflets may be obtained free on application to the Ministry (Publications), Ruskin Avenue, Kew, Surrey. Copies beyond this limit must be purchased from Government Bookshops, price 3d. (by post 5d.).

No. 160. Swift Moths (*Amended*)

No. 319. Soil Sterilization (*Revised*)

No. 433. Control of Rushes (*Revised*)

FARM MACHINERY LEAFLET

One free copy of Farm Machinery Leaflets may be obtained on application to the Ministry (Publications), Ruskin Avenue, Kew, Surrey. Copies beyond this limit must be purchased from Government Bookshops, price 6d. (by post 8d.).

No. 24. Forage Harvesters (*New*)

HORTICULTURAL MACHINERY LEAFLET

One free copy of Horticultural Machinery Leaflets may be obtained on application to the Ministry (Publications), Ruskin Avenue, Kew, Surrey. Copies beyond this limit be purchased from Government Bookshops, price 6d. (by post 8d.).

No. 1. Glasshouse Heating Systems (*Revised*)

FREE ISSUES

Obtainable only from the Ministry (Publications), Ruskin Avenue, Kew, Surrey.

Silver Leaf (*New*)

In Brief

COUCH CONTROL

Two answers given by the chemists to the problem of couch are dalapon and amino-triazole. Both act by absorption through the leaves and are therefore best applied when the couch foliage is green and making active growth.

Early autumn is a good time to use dalapon on couch-infested stubble, but it should be stopped as soon as frosts have started.

Spring treatment is also suitable, provided sufficient time is allowed between spraying and the planting of the next crop for the chemical to be broken down and dispersed in the soil. This time is dependent on factors such as the dose applied, soil type, and weather conditions. In any case it is not advisable to sow spring cereals and spring-sown grasses following the use of dalapon in the spring. Other crops should not be sown for 6-8 weeks after an application of about 12 lb dalapon per acre. The dose of dalapon generally used is 8-12 lb acid equivalent per acre in 20 gallons of water, smaller doses being used in the spring than in the autumn.

The control obtained by dalapon varies with the type of couch being treated, onion couch being the most resistant. In general, the greater the dose the better the control, although even quite large doses can be comparatively ineffective unless further management of the sprayed area is aimed at enhancing the effect of the chemical. A main effect of dalapon is to induce dormancy: subsequent death or survival of the rhizomes can be influenced by management. Ploughing as deeply as practicable 2-3 weeks after spraying is advisable. Where ploughing is impracticable other cultivation treatments should be substituted. Ploughing or cultivation should not be carried out sooner than a fortnight after spraying, which gives time for the chemical to be carried down to the roots, but cultivations should not be delayed longer than necessary after this time. The effect of dalapon can be further enhanced by planting a competitive crop such as kale which will smother any surviving shoots.

As regards amino-triazole (ATA, Amitrol), an activated formulation first marketed in 1959 is claimed to give good control at doses of 4 lb of ATA per acre. Conditions of use of this formulation are similar to those stipulated for dalapon: it should be applied to actively growing couch in 20 or more gallons of water per acre; subsequent management is also necessary to complete the effects. ATA is less persistent in the soil than dalapon: at the recommended dose the manufacturers state that the subsequent crop can be sown or planted immediately after ploughing and cultivations 2–3 weeks after spraying.

Recent experiments have shown the value of the rotary cultivator in controlling couch (*Agropyron repens* and *Agrostis gigantea*). The method used is essentially one of exhaustion whereby the buds on the rhizomes are stimulated to grow, and the resultant shoots then destroyed by a series of rotary cultivations. The first cultivation should be made with the tractor in bottom gear, preferably on consolidated as opposed to recently cultivated land, so that the rhizomes are cut into very small pieces (about 4 inches). Further rotary cultivations are then made each time the re-growing shoots reach about 2 inches in height until no more shoots appear. The number of rotary cultivations necessary appears to vary between two and five, according to soil type and weather.

OAT HAY IN WALES

It is a traditional practice in many hill areas in Wales to grow oats for harvesting at the near-ripe stage of growth. The crop is generally cut two or three weeks

before it is binder ripe; that is, when the grain is soft and milky and showing only slight yellowing The yellow colour of the straw at this stage would begin to predominate over the green. The practice has been found to have important merits:

1. A high yield per acre of very palatable fodder is assured, and a "full barn" is always a highly desirable goal on hill farms where a long winter is often in store.
2. Harvesting of the crop is relatively safe, even under inclement weather conditions—the crop is generally cut with a binder and stooked in the usual way; drying out takes up to three weeks before the sheaves are fit to store.
3. Valuable fodder is produced and threshing costs are avoided.
4. The crop is a useful "nurse" for an undersown grass and clover ley.

The value of this widespread practice is now supported by the results of an investigation carried out over three years at Aberystwyth. (J. L. Henderson and R. O. Davies, *Empire Journal of Experimental Agriculture*, Vol. 23, No. 90, April, 1955.)

Discussing the results, the authors state: "In this experiment, taking the average of the three seasons, the dry matter yield of the oats reached a maximum two or three weeks before the full ripe stage, and, as the crude-protein percentage in the dry matter remained fairly constant in the last stages of sampling, the crude protein yield of the whole plants showed little variation over the ripening period. It would follow, therefore, as shown by Berry, Watkin, and Smith and Robb, that the increase in the yield of crude protein in the oat grain over the final stages of ripening was due entirely to translocation from the other parts of the plants".

The choice of the best variety for the purpose is important. The Aberystwyth bred S220 spring oat is particularly suitable, as it tillers well and produces a high yield of total fodder per acre. The more recently introduced spring oat Manod, which is resistant to mildew, crown rust and stem eelworm, will certainly have a place as a fodder oat. It grows well under upland conditions where the fertility is good, and, being resistant to mildew, the leaves of the plants are not subject to the great physical losses in food material which can arise in non-resistant varieties.

Evan I. Prytherch

THE LAST OF ARSENIC AS A HAULM-KILLER

Although there are now serious doubts about the value of potato-haulm killing as a preventive of tuber infection by blight, there is no doubt at all that it makes lifting easier, especially when a wet autumn turns potato fields into an impenetrable mass of lush tangled growth of haulm and weed. But arsenic—used extensively as a haulm-killer in recent years—is nasty stuff to have about the place: and everyone concerned is agreed that after stocks have been used up this year, its use in the potato field should stop.

Manufacturers and farmers are joining with the Ministry in a concentrated effort to make certain that its passing is not marred by accidents to man or beast.

The protection of workers will be ensured by compliance with the regulations about wearing protective clothing—not only when spraying but also when preparing the spray. If the crop is lifted within ten days of spraying, the law says that pickers, too, must wear special clothing—an overall, rubber gloves and boots and a dust-mask—but it is much better to wait for the ten days to pass.

Livestock will come to no harm if fences are really stockproof and gates securely fastened. If animals are kept out of adjoining fields, so much the better.

Other precautions will occur to intelligent growers: careful disposal of con-

tainers, the erection of warning notices at field entrances, prevention of spray drift and so on.

Neighbourly co-operation, goodwill and care will all add up to a safe 1960 potato harvest—the last in which arsenical haulm-destroyers will be used.

ANIMAL HEALTH IN BRITAIN, 1958

The comprehensive Report on the Animal Health Services in Great Britain for 1958 shows that the year was, on the whole, a comparatively good one from the point of view of outbreaks of notifiable disease. The Report explains the methods used to restrict the introduction and spread of animal diseases in Britain.

Results of experiments undertaken by the laboratories and on farms to diagnose, control, and eradicate disease form the greater part of the book and are an interesting feature of the publication. Information is also given about the export of livestock and various products, and the protection of animals during transit.

The Report is published by H.M. Stationery Office, price 6*s.* (by post 6*s.* 6*d.*).

WATCH FOR HUSK

It is doubtful whether any system of management can be devised which will prevent husk among calves in all circumstances, but it is possible to avoid a number of situations which may be particularly dangerous. Cattle quickly become resistant to lungworm infection after being exposed to it. The strength of their resistance depends on how much infection they have experienced. Most outbreaks of husk are therefore the consequence of sudden exposure of insufficiently resistant animals to grazing which is too heavily infested.

Heavy infestations of larvae on the pasture do not persist for long, and attention should be directed to infested animals passing larvae in their dung and so contaminating the pasture anew. Under suitable conditions, especially when the grass is growing quickly, even very small numbers of larvae in dung can quickly give rise to heavy herbage infestations.

Young animals begin to pass larvae in their dung three weeks after they become infected. Within another eight weeks they throw off most of their worms but, particularly if they were lightly infected, they may continue to pass small numbers of larvae for much longer periods. They are still likely to contaminate pasture in the following spring.

Susceptible calves should not run with animals which may contaminate the pasture, nor graze pastures which such carriers of infection have occupied. Whether it has ever shown symptoms of husk or not, any animal that has been out at grass either in the previous year or earlier in the current season must be regarded as a potential carrier. The younger it is the more likely is it to contaminate the pasture.

Last year's calves should therefore be removed by the beginning of March from land which is to be occupied by the new crop of calves, and such of these as are to run together or occupy the same ground should all be turned out at the same time lest those turned out earlier should build up on the pasture a level of infestation dangerous to those turned out later. The increasing resistance of calves will normally keep pace with the increasing infection that they will meet when they themselves contaminate the pasture, but it may fail to do so if conditions favour an unduly rapid increase in the herbage infestation. This is particularly likely in the case of calves that have been withheld from infection for a period. Movement of the calves from one pasture to another, especially from bare pastures to a lush aftermath, can therefore be dangerous.

A form of vaccination against husk is now available and, though the long-term effects of its use are not yet known, it does appear to give calves a measure of

resistance at the start of the grazing season which proves sufficient if sudden exposure to heavy infestation can be avoided.

H. I. Field.

BULK HANDLING OF APPLES

An entirely new technique of mechanical handling, developed in New Zealand, has been making rapid progress overseas, particularly in the Commonwealth. By this new technique, known as Bulk Handling, apples are harvested, carried and stored in bulk bins which usually hold 20–25 bushels.

A few apple growers in this country have adopted this technique and so made it possible for the Ministry to make a small-scale investigation of what bruising occurs.

The variety was confined to Bramley's Seedling. Thus the results cannot be taken as conclusive, but because of growing interest in the new development the Ministry has released a report on the investigation which draws the following preliminary and tentative conclusions:

1. The amount of bruising in Bramley's Seedling apples is likely to be less when bulk bins are used instead of bushel boxes for harvesting.
2. If the bins are not too deep, bruising is likely not only to be less but of a less severe nature than that which occurs in bushel boxes.
3. There would appear to be an advantage in using a bin no deeper than 21 inches.
4. On the minority of farms where the normal method is to use half-bushel trays, Bramleys harvested and stored in bins may sustain more bruising.

The report also contains general information about bulk handling. Copies can be obtained on application to the Ministry of Agriculture, Fisheries and Food, Horticulture Division 1, St. Andrew's Place, London, N.W.1.

F.A.O. WORLD SEED CAMPAIGN

Next year will see a world-wide campaign launched to encourage the use of better seeds. In the United Kingdom the campaign will have two main features: the provision of educational courses for students from the less developed countries, and a drive for the wider use of high quality seed of improved crop varieties in the United Kingdom.

A six weeks' course in seed testing and certification is being arranged at the National Institute of Agricultural Botany at Cambridge for up to twenty people from less well developed places; the Ministry of Agriculture for Northern Ireland is offering practical training to overseas students in seed testing and certification, and the Department of Agriculture for Scotland will provide facilities to enable foreign visitors to learn about the seed testing and certification work carried out in Scotland. The Forestry Commission will also be participating as far as possible in respect of forest tree breeding and seed production.

To emphasize the importance of using high quality seed of improved crop varieties, seed improvement will be specially featured in the United Kingdom during 1961.

A national Crop Conference will be held at the National Institute of Agricultural Botany in December 1960 and will have as its theme "Better Seeds: Better Crops".

Also the National Agricultural Advisory Service is planning to supplement its normal advisory work with activities such as regional conferences, discussions, exhibits and demonstrations.

Book Reviews

Vocabulary of Animal Husbandry Terms (English, French, Spanish, German). Compiled for F.A.O. and European Association for Animal Production, Rome, by A. KIENER, H. LÖRTSCHER, H. R. DAVIDSON and R. OLALQUIAGA. 55*s*.

The technical and advisory work of F.A.O., the general increase in international contacts of all kinds, and particularly the commercial and political implications of the Common Market and the European Free Trade Association, have greatly increased the need for more accurate translation of both the written and the spoken word in agriculture.

Although there are already a number of dictionaries and glossaries of agricultural terms, they vary considerably in achievement. The two main difficulties with such publications are: to find in the compilers the proper combination of editorial experience and technical knowledge of nuances and synonyms; and to know how far to go in covering synonyms and associated terms, possibly at the cost of limiting the scope of the whole work.

Perhaps the main problem arising from the modern fragmentation of science and technology is that agriculture is now far too large a science for which to try to draw up an adequate vocabulary. For proper interpretation and international understanding the various senses and synonyms of terms must be properly codified. Mere approximations, as, for example, when a substantive is translated by a verbal or adjectival term, are of little real help. The restriction of this vocabulary to animal production has allowed a considerable amount of specialization, but even within this limit the work had to be confined. For example, in anatomy, physiology and veterinary science it has been necessary to limit the scope to terms in common use by stockkeepers and their technical advisers.

In this publication the compilers have made a commendable attempt to correlate synonyms in the four languages as closely as possible. It was a very difficult task because, even within one nationality, synonyms differ in use and interpretation. This is seen, for example, in the language of sheep husbandry as it has developed and still exists in England, Scotland, Wales and Ireland, and even within localities of these countries. To collect synonyms of the principal word for the same concept in each language is a sufficient task. It does not follow that the synonyms in any one language will be the best translations of synonyms in the others, and so it has been necessary to clarify terms as far as possible; but the compilers are at pains to explain that they have not attempted definitions.

"The vocabulary which is presented in this first edition makes no pretence at being complete. It represents merely a foundation on which to build with the experience gained from use in practice." This excerpt from the introduction shows that the work is not a commercial undertaking aimed at making quick profits, but an attempt to build up a solid foundation for more effective inter-European contacts. Readers and users could do much to help by sending in their suggestions for improvements and new material to the Secretary of the British Society of Animal Production.

The vocabulary itself is presented under nineteen main headings and numerous sub-headings, within which words and terms are grouped according to linguistic or subject similarity. In addition there are alphabetical indexes in each of the four languages, with code letter references to the vocabulary itself and the 5,800 words which it contains.

Copies are obtainable from the Secretary, British Society of Animal Production, King's Buildings, Edinburgh, 9.

English Field Systems. H. L. GRAY. Merlin Press. 63*s*.

Dr. Gray's book was first published in 1915, and it is a measure of the depth and understanding of his research that it is still the basic standard work on the subject. This new impression reproduces the original text, although in certain respects more recent work has modified his conclusions.

The author was not primarily concerned with the detailed working of the open-field husbandry: on this aspect the general reader is better served by the Orwins' book, *The Open Fields*. Gray's chief aim was to show that the typical open-field system of the Midlands was found in a well-defined area, beyond which it took various different forms. Thus he describes an East Anglian and a Kentish system, and others practised in the Lower Thames Basin and in some northern and western counties.

The typical Midland system is shown to have existed in some twenty-four English counties. Its chief characteristics are described: the arable land of a village was divided into two or three large fields, one of which lay fallow each year. A man's holding was equally distributed between these fields so that he had a fair share of cultivated and fallow land; and all landholders enjoyed common pasturage over the fallow field. But Gray fully realized, as more recent work has confirmed, that this ideal system was in practice often greatly modified, and he discusses the various methods by which the two or three field system was improved.

Of the open-field systems outside the Midland area, Gray was less certain, and later work has thrown further light on, for example, Lancashire, Norfolk, Kent, Wales and south-west England. But much still remains to be explained, and Gray's thoroughly-documented work will long provide the starting point for future studies.

K.J.A.

British Ferns and Mosses. (Kew Series, Vol. 5). P. G. TAYLOR. Eyre and Spottiswoode. 25*s*.

Although some farmers have good cause to know bracken and field horsetail, very few people can name the numerous beautiful and harmless British ferns and mosses, and many have never heard of the quillworts, clubmosses and selaginellas. This is partly due to the shortage of suitable books on flowerless plants, so the production of a really usable guide to the mosses, ferns and their allies is very welcome.

Naturally, when starting to study plants differing so much in appearance and life cycle from the more familiar flowering plants, there are new terms to be learnt, but after reading the lucid explanations in the introduction the descriptions of the species are easy to follow. The key to the ferns and their allies depends on characters visible to the naked eye or with a hand lens, and a mature specimen can be identified with certainty. The excellent drawings and coloured pictures help. Many species have unique features by which they can be recognized, and these are mentioned in the descriptions. Habitats and regions where the species occur are given, but for the rarities only the general locality is stated and the fortunate finder is encouraged to avoid damaging the plant.

Botanists usually use microscopes to study mosses, but the descriptions here are limited to what can be seen with a hand lens, though the wonderful details revealed by the microscope are sometimes mentioned. It would not be feasible to include all the 600 British mosses in a book of this size and scope, but about fifty common species are described and illustrated, enabling an amateur to identify most of his finds.

This book is so straightforward that ferns and mosses need no longer be regarded as too difficult for amateurs to study. It should arouse widespread interest in this neglected section of the British flora. Only living species are dealt with, the fascinating but more difficult subject of their fossil relatives being left to the specialists, but the bibliography suggests some more-advanced reading.

J.M.T.

Pigs: Their Breeding, Feeding and Management (7th edition). V. C. FISHWICK (Edited by W. ANDREW BIGGAR). Crosby Lockwood. 20*s*.

When reading this book it is easy to realize why the late V. C. Fishwick was so widely known for his work with pigs. The presentation is easy to read, and clearly indicates that the author had a very intimate knowledge of pig husbandry at an essentially practical level. Such a person is in an excellent position to apply science to practice and obtain the best from the combination.

However, pig husbandry has made rapid strides in the last ten years, particularly as regards feeding and housing. Feeding is, of course, the most important single factor influencing profit and loss. It is surprising to read of the emphasis given to weatings as a necessary component of the ration.

More surprising still to realize on reading page 39 that, at current prices, the cereal portion of the low standard ration would cost more per unit of starch equivalent than the cereal portion of the standard ration. The increased proportion of weatings is responsible for this.

The recommendation of putting 50 per cent weatings in a creep feed ration is not in line with the need to provide the younger animal with a high energy, low fibre diet. As a contrast, the example given of using pigs to recover fallen barley is most illuminating, and could be copied by many pig farmers in times of difficult harvests.

Any recommendation regarding pig housing must be of a general nature because of the lack of precise information on the subject. In spite of this, the author of the chapter on housing could more helpfully have given details when suggesting that a more expensive house, offering conditions above average, would result in extra profit. What is an expensive house? What are average conditions?

The chapters "Costs and Returns" and "Marketing and Grading" contain information which, if intelligently applied to any pig enterprise, must increase the margin of profit.

There is a great deal of useful material in this book, but one gets the impression that the attempt to put new wine into an old bottle has not been entirely successful.

J.R.L.

British Poultry Science (Volume 1, No. 1). Oliver and Boyd. 17*s.* 6*d.*

The first number of this new periodical appeared in April 1960, and further issues are planned at six-monthly intervals. Sponsored by the Poultry Education Association and with an impressive backing of consulting editors, it is modelled on the familiar *Poultry Science*, but specializes in poultry reviews and research articles from U.K. and British Commonwealth sources. French and German summaries of each paper are included, and editorial policy is to cover the whole field of poultry science. In view of the increasing volume and standard of material that has hitherto been dissipated among specialized technical journals that seldom reach the ordinary public, the need for some such publication is considerable.

The honour of contributing the opening article goes to Miss C. M. Ann Baker, who reviews no fewer than eighty individual sources of genetic information (dating from 1920 onwards) on the subject of egg quality. In her discussion, Miss Baker regrets that very little of all this information is of really practical use and explains that even the meaning of the very word "quality" as applied to eggs is difficult to define precisely. She considers that while it would be impracticable to analyse every flock genetically, a useful approach would be to subject the leading flocks at our official Poultry Progeny Testing Stations to more detailed scrutiny.

An experiment on inducing out-of-season egg production in turkeys through controlled lighting is described by Clayton and Robertson, who conclude that all-the-year-round production is practicable. Controlled lighting is also discussed by Morris and Fox in relation to sexual maturity in pullets. In their experiment, a pattern of declining daylight from 0 to 17 weeks of age delayed sexual maturity by about 24 days and resulted in more and larger eggs during the pullet year, net profitability being raised on average by 7*s.* 2*d.* per bird. Restricted feeding of growers is discussed by Gowe *et al.* (Canada), whose experiments also showed increased profitability in spite of greater mortality and delayed maturity. The remaining articles bring the issue to seventy-two pages, produced to the high level of readability for which the publishers are famous.

Since its inception in 1930, P.E.A. has had its ups and downs in furthering poultry education. Its current members (who number only about 100) are therefore to be congratulated on their courage in this new and ambitious venture. We offer it a warm welcome and trust that future issues will maintain the same high standards as this first issue.

G.E.M.

Tomato Growing by Prescription. REUBEN DOREY. Blandford Press. 18*s.* 6*d.*

While many books have been written on the cultivation of tomatoes, Mr. Dorey's approach to the subject is a new one. The influence of a scientific training in chemistry is reflected in the detailed discussion of elements required for plant growth, and the way in which they are combined to the best advantage. It may be that the practical grower will find these sections rather heavy going, even though they have been simplified as much as possible.

Botanical information is well set out, though most of it applies to plants generally and is not specific to the tomato. The diagrams throughout are helpful in explaining the text, and soil sterilization by steam is described in some detail. Experimental work done at the National Institute of Agricultural Engineering and at experimental horticulture stations is quoted freely, and here also the diagrams in this section enable the reader to grasp essential facts more easily.

In glasshouse construction, single houses which are wide and high, and admit the maximum amount of light, are favoured. The disadvantage of building on a slope is mentioned, but the importance of a perfectly level site in obtaining uniform temperatures in the house—which must be an important factor in precision growing—might have had more emphasis.

A programme of liquid feeding covering the life of the crop is given, though it is made clear that it is intended only as a guide. In this connection, and in a number of other instances, the prescription may be varied by the grower according to the behaviour of the plant, and while the number of alternative methods of producing a crop may have been reduced, the grower must still make his choice. Because of this, the title of the book may be slightly misleading, in that no precise formula for growing a heavy crop of good quality is set out. This is not surprising as, in spite of the amount of research work carried out in this country, on which the author has drawn freely, much remains to be done before such a formula can be produced. Even when the best environmental and other conditions for the plant at all stages of growth have been established by experiment, there may still be some difficulty in providing these conditions in the average commercial house.

This book contains much useful information, and should prove rewarding to growers and to others interested in the modern approach to the production of a tomato crop.

A.D.H.

Potassium Symposium, 1958. International Potash Institute (Berne). *Sw. fr.* 19.

The theme of the International Potash Institute's fourth congress in Madrid was the role of potassium in the plant/soil/water relationship. Only four of the twelve papers presented were in English, but this multi-lingual symposium contains English summaries of all the papers, plus an English subject index. It is, in fact, a very mixed bag. Most of the crops discussed are tropical or sub-tropical, and much space is devoted to the application of potassium fertilizers under arid conditions and in saline irrigation water.

Two papers, however, are of interest to British horticulturists. Professor J. P. Hudson of Nottingham University, reviewing the influence of potassium on the water economy of plants, points out that it has two distinct and opposite effects. In the soil, by affecting the osmotic pressure of the soil solution, it can decrease the availability of water to the plant. But in cell sap its presence increases the plant's water absorbing powers.

Experimental work at Nottingham had demonstrated that well-watered tomato and lettuce plants, grown in soils previously salinized by copious draughts of potassium and magnesium sulphate solutions, produce the tough leathery leaves normally associated with drought conditions. In practice it is only in glasshouse soils, where high salinity has been built up by continuous heavy fertilizer applications, that potassium plays an important part in governing water uptake. Such soils commonly contain the equivalent of 60–80 cwt per acre of potash. But healthy crops can be grown in soils with a surprisingly high potassium content, provided irrigation water is applied frequently enough to prevent the development of high moisture tension, although for success considerable skill is required. An interesting alternative is "osmotic control", whereby the relation between vegetative growth and fruiting in tomato plants is controlled by using highly concentrated liquid fertilizer in which potassium salts are an important ingredient.

Professor Wallace of Bristol University quoted experimental evidence supporting the view that potassium fertilizers are only likely to be effective in soils where increased moisture is not accompanied by bad aeration. Seasonal waterlogging, especially if alternating with drought, seriously impedes potassium uptake by fruit crops.

The book is obtainable from the International Potash Institute, P.O. Box Berne Transit, Switzerland (payment to be made through a bank or by postal order to the Institute's account at the Union Bank of Switzerland in Berne) or through any bookseller.

S.L.

Mist Propagation of Cuttings. (Commonwealth Bureau of Horticulture and Plantation Crops Digest No. 2.) PATRICIA ROWE-DUTTON. Commonwealth Agricultural Bureaux. 10*s*.

Many woody plants can be successfully propagated by softwood cuttings, provided the cuttings can be kept alive and turgid long enough. In the past, skilled propagators have used carefully shaded, double-glazed propagating frames and frequent syringing to reduce water loss from the cutting and to keep its leaves cool. The skill and labour required severely limit the large-scale use of this method, especially in recent years. New automatic methods have, therefore, been developed, especially in the U.S.A. where labour is scarcest, the most successful one being mist propagation. In this a film of water, maintained by automatically controlled mist sprays, covers the leaves and protects them from water loss, and also keeps them cool so that shading is not necessary. The extra light thus reaching the leaves enables them to build up carbohydrate reserves, which can aid rooting and subsequent growth.

Interest in this new method has developed in other countries also, especially in Holland and Great Britain, where research has led to many modifications. There are now a variety of systems of achieving suitable conditions and, in this digest, Miss Rowe-Dutton has summarized information on them to guide growers who wish to install and run their own propagation unit.

An essential part of the method is the instrument for controlling the periods of applying the mist. Eight different systems are described, with most detail about the so-called "electronic leaf". Smaller sections of the booklet deal with nozzles and all the other parts of the apparatus, and a most useful appendix provides the addresses of suppliers of the equipment. Information is given on how to use the equipment and treat the cuttings.

Some of the most difficult problems arise after the cuttings are rooted, when they have to be established outside the propagation beds. These problems are fully reviewed, and hardening off methods described.

The references in the text to the extensive bibliography are not too easy to use, but for practical growers the details given are adequate and there should be little need to refer to the original papers. An appendix contains details of humidification methods, mainly because they may be useful in combination with mist. The illustrations are excellent, and there are extensive tables of results obtained with over 1,000 different plants.

H.B.S.M.

Broiler Farming. RAY FELTWELL. Faber and Faber. 15*s*.

To write anything on broiler production in Britain is to count on its being out of date by the time it is printed—the industry is developing so fast.

In this book, the short and challenging section on broiler production contains some ideas of economic margins and profits that the would-be entrant to the industry would be well advised to scale down when making his budget appreciation. A margin of 6*d*. to 8*d*. a bird over all costs might be a realistic figure to expect. Housing, breeding, brooding, feeding and general management are briefly and practically dealt with.

While accepting, and generally agreeing, with the author's description of the broiler system, and also that it is a possible method of rearing table ducklings, it is hard to accept his thesis that the system would be equally applicable to the rearing of replacement laying pullets or capons. The broiler system uses the quick growth and good food conversion of the early weeks of the chick's life for the economic production of table poultry meat. To apply such a system to the rearing of replacement laying pullets or capons would be both illogical and uneconomic: these categories of fowl, maturing later than broilers, require quite different systems of feeding and management. It may well be that the author has not clearly differentiated in his own mind between the broiler system and the other forms of intensive rearing of chicks which are becoming more general. If this is so, he has unwittingly confused the issue for the inexperienced reader.

In the section on capon production the techniques of chemical treatment with synthetic oestrogens are lucidly dealt with, but the warning about safe storage and careful handling of these products could well have been given more emphasis. Production of table ducklings, geese and turkeys, including the sixteen-week turkey, are very briefly touched upon.

The print is clear and easy on the eye, and the book is well produced and illustrated both with photographs and, in the section on housing, useful line drawings.

W.M.A.

Practical Shepherding (2nd Edition). H. G. CLARKE. Farmer and Stock-Breeder. 9*s.* 6*d.*

Though perhaps it will not add much to the knowledge of the experienced flock-owner, this little book will be of considerable help to the novice who is starting a sheep enterprise. The first chapter, "Commencing a Grass Flock", contains some very sound advice on the choice of types for a commercial flock; so do the chapters on flushing and mating.

Rightly, the author lays great emphasis on the need for adequate nutrition of the in-lamb ewe; this neglected aspect of sheep management is fortunately receiving much more attention than it did in the past, because today more consideration is being given to the urgent need for a good crop of lambs with abundant "birth vigour".

The chapter on lambing is good because it deals in simple language with abnormal presentations. These, providentially, are not of frequent occurrence, and the author's treatment will inspire the novice with confidence.

But some criticism of the book cannot be avoided. Referring to the treatment and control of foot rot, Mr. Clarke makes no mention of the use of formalin in the foot-bath; yet it is widely recognized today as being by far the best and safest substance to use because it does not harden the foot, as do copper compounds. The author is very sound in his reference to the seriousness of foot rot in rams; so many sound flocks have been infected by the unwise purchase of rams whose feet have been patched up before the animals were offered for sale; when they are put to work the infection they carry becomes active.

Another serious criticism must be made of the author's treatment of the control of intestinal worms. He appears to advocate routine dosage; but surely we now know so much more about the problems of worm control, by careful grazing management, that the routine dosage programme is rather outmoded. Moreover, the early disposal of lambs before weaning means that anti-helminthic dosage is unnecessary, particularly when the autumn dosing of ewes is practised.

Mr. Clarke seems to be strongly opposed to the use of vaccines and sera to control lamb dysentery and pulpy kidney losses. How many large flockowners would agree with him, I wonder?

J.F.H.T.

Principles for British Agricultural Policy. Edited by H. T. WILLIAMS. Oxford University Press. 18*s.*

A great deal has been packed into this very readable book, but nothing new will be found on "principles". Indeed it may well be asked whether the title is the correct one for a work of this nature, which is more of a compendium or concise survey of many, if not all, aspects of agriculture. It is a mixture of country-wide, sometimes world-wide, surveys or sweeps, and of detailed information right down to eelworms and their eggs.

Since the book is supposed to deal with principles for policy, and because considerable stress is laid upon the steps to be taken in preparation for and during war, one would have hoped for more information on what happened during the last war. Pre- and post-war figures are given in some detail; indeed the economic and statistical information makes interesting reading.

The writers seem to say, quite rightly, that the principles for agricultural policy should be economic efficiency, perfection in cultivation methods and maximum output with as much self-sufficiency as possible. No one will wish to argue about these, for they have been the targets for many years. Indeed, had this book been issued a year or two after the end of the last war it would have made a much greater impact than it will now. Nevertheless it should be useful for students, in that it gives a bird's-eye view of agriculture during the first half of this century.

There are several points of detail which need to be altered or corrected. In at least two places reference is made to the subsidies paid to farmers since the war. It is not made clear that £250–300 million is an annual figure; the total cost since the end of the war is approximately fifteen times this. Thus, to raise agricultural pro-

duction by 63 per cent has cost £3,750–4,500 million in subsidies. In addition, farmers have received free assistance and advice from members of the National Agricultural Advisory Service, universities, colleges and research institutes, all of which has cost many more millions.

On page 172 the county referred to should read Hereford, not Hertford.

C.V.D.

Hardy Herbaceous Plants. LANNING ROPER. Penguin Books. 6*s*.

There was a time just after the war when we felt gloomy about our gardens: we could not see how we could afford to employ any gardeners at all, and thought that the herbaceous border of former times was doomed. But things have not worked out quite like that, as thousands of gardens in Britain can still boast herbaceous borders. There are thousands more with borders that could hardly be called "herbaceous", but are nevertheless gay and cheerful in the summer months.

We must look to the hardy perennials to provide the backbone of our garden display, and Mr. Lanning Roper has realized that the lavish herbaceous border is not for everybody. In the first few pages he says that we may well find ourselves using herbaceous plants in mixed plantings—combining them with flowering shrubs to give one of the most beautiful of all compromises.

Whatever use we wish to make of herbaceous plants, we shall find help in this book. Planning the border, planting it, supporting and tying, propagating and looking after herbaceous plants when they are attacked by pests or diseases—all these problems are fully discussed. There is a chapter on "The Mixed Border", and another on "Herbaceous Plants for Woodland Gardens". In the various appendices, the author gives much advice about the important genera of herbaceous plants, such as irises, delphiniums, paeonies, lupins, asters and phloxes. He also lists the plants that are useful to those who want flowers to cut and dry for winter use, others which are suitable for ground cover, chalky soils, dry sunny positions, shade, and so on. This is yet one more worthy addition to the Penguin series, and with its lavish illustrations is excellent value.

R.H.

Electricity and Problems of Animal Environmental Control. D. W. B. SAINSBURY. Electrical Development Association.

This booklet comprises a paper read by the author at the E.D.A. Rural Electrification Conference, 1959.

The need for a controlled environment for young stock, fattening pigs and all classes of poultry is emphasized. Temperature, humidity, air movement and light are listed as the principal environmental factors, and their separate influence is discussed. It is rightly stressed that knowledge of precise requirements is lacking at present, but some very useful tables and formulae provide temporary working yardsticks for those intending to construct intensive housing units.

Particular and interrelated effects of ventilation, air movement, thermal insulation and vapour barriers are clearly described. This is refreshing, as there has been much muddled thinking in this connection. In drawing attention to the trend towards powered ventilation some of the common errors in installing fans are cited, and some useful general recommendations are given to help achieve good ventilation by artificial means.

Although a table of "U" values for various materials used in roof and wall construction, and another of "K" values for a series of materials used for thermal insulation, are given, it would have been helpful if one or two examples had been included to show the method of arriving at the overall value for a complete house.

Reference is made to recent experimental advances in the light requirements of poultry, and a distinction is drawn between the needs of growing and laying birds and of fattening stock. In both cases intensity of light is less important than duration. The provision of an artificial light pattern, involving a diminishing day length, during growth has an important bearing on age at sexual maturity and egg weight and, to a lesser extent, egg yield. The effect of a progressive increase in the duration of light during the laying stage is less certain, but mention is made of the promising results of work in America, where birds have been subjected to "perpetual springtime". These arrangements involve windowless houses and complete reliance on artificial light.

All interested in the intensive housing of farm livestock should read this well-illustrated twelve-page booklet, which is stimulating and thought-provoking.

Copies of the publication, EDA No. 1897, are obtainable free from the Electrical Development Association, 2 Savoy Hill, London, W.C.2.

H.T.

The Major Land Uses of Great Britain (Studies in Rural Land Use, No. 4). R. H. BEST. Department of Agricultural Economics, Wye College. 10*s.* 6*d.*

Mr. Robin Best is to be congratulated on a painstaking study of the validity of the principal figures available of the various uses of land in England and Wales.

Agriculture is the main use, and the annual returns collected by the Ministry of Agriculture from farmers form the chief source of the figures. In his report the author shows that calculations based on a belief that the difference between the agriculture figures, which include woodland, and the total land area is urban land can be very misleading. This becomes obvious with the details given in his examination of the difference.

The agricultural returns are contrasted with those obtained by the Land Utilization Survey organized by Professor Dudley Stamp. This source shows about one and a third million more acres in agricultural use than do the Ministry's figures in a roughly corresponding period. Conversely, the L.U.S. gives a figure of two and three quarter million acres for urban land, and this, of course, is one and a third million acres less than the difference figure between the Ministry's agricultural area and the total land area.

Differences in purpose, and also in definitions, in the collection of the two sets of figures, contribute in part to the discrepancy between the agricultural areas given. The L.U.S. result is regarded as the more significant of the two for the purpose of allocating land use. However, it is very difficult to determine, even on the ground, where the change from town to country takes place, and it is unlikely that completely distinctive definitions can be given. Nevertheless, in these times, no one connected with or affected by planning will fail to support the author's conclusion that the statistics of land use in this country require further explanation. No doubt his suggestions for the better definition of urban and rural uses, and for the improvement of the methods of collecting statistics, will not pass unnoticed.

J.R.L.

Fertiliser Report and Statistics, 1959. Fertiliser Manufacturers' Association. 6*s.*

There are plenty of statistics on the consumption and field use of fertilizers, but they are scattered and sometimes the needed figure is difficult to find. The Fertiliser Manufacturers' Association have done a good job for the increasing number of people—students, teachers, advisers, technical journalists and even politicians—who want to be fully informed on the present-day position of fertilizers in this country, as well as in trends in their manufacture and distribution between the important crops. At first sight this might suggest a dull book, but all the colourful arts of presentation have been called in to encourage and sustain the reader.

Apart from the Association's own data, the information is derived from the Ministry of Agriculture, the Board of Trade, the Organisation for European Economic Cooperation and the Surveys of Fertilizer Practice conducted by Rothamsted in conjunction with the National Agricultural Advisory Service and the Fertiliser Manufacturers' Association.

So far as consumption is concerned, the main data and discussion relate to what has happened in the last five years. Nitrogen has increased by 31 per cent, phosphate by nearly 10 per cent, and potash by 42 per cent. Other useful figures in this section show the increase in tonnage and concentration of compound fertilizers, and the changes in their nutrient ratios. We are also told the amounts of each of the nutrients used in compounds and as "straights". This useful word is explained in the glossary and has now lost its quotes. Any nineteenth-century implication that compounds were in some way "crooked" has now, of course, completely disappeared.

How fertilizers were actually used in 1957 and 1958 is set out by provinces for the various crops, including temporary and permanent grass. This information is derived from the Fertilizer Survey, and the inclusion of these figures may induce readers to study the more detailed original reports dealing with smaller, well-defined areas.

Other tables show the trends of regional consumption of each main nutrient in straight and compound form, and there is a useful set of diagrams showing the yearly acreages of each of the common crops since 1943.

This is a valuable book of reference, and the hope is that a new edition will be forthcoming when there are significant changes to record.

Copies may be obtained from the Fertilizer Manufacturers' Association, 44 Russell Square, London, W.C.1.

H.V.G.

The Cool Greenhouse. G. W. ROBINSON. Penguin Books. 6*s*.

Nowadays, with electrical heating of greenhouses becoming commonplace, thousands of gardeners are beginning to savour the joys of heated glass. They are finding that they can set plants in their gardens weeks before their less fortunate neighbours. There is also the joy of bringing flowering and foliage plants into the house, as well as the pleasure of a sheltered haven in which to work among their beloved plants, even in the most inclement days of winter.

In this handbook, Mr. Robinson has given all the information that the amateur could want about the choice, heating, and stocking of a greenhouse. He gives full information on routine, which after all is most important. No book can really teach the art of watering, or how to know as soon as the greenhouse door is opened whether the atmosphere is right. These things must be learnt by experience, but the author goes a long distance on the road which must be trodden the hard way.

The rest of the book contains chapters on such topics as "Shrubs for the Cool Greenhouse", "Tender Herbaceous Plants", "Climbing Plants", "Orchids", "Pelargoniums", "Chrysanthemums" and "Carnations". But Mr. Robinson not only tells about the plants that can be grown, he gives the quintessence of his long experience in the cultivation of all these plants. I consider that if anyone has spent £50 on a greenhouse, Mr. Robinson's six shillingsworth is cheap at the price.

R.H.

Books Received

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Lawns. R. B. Dawson. Penguin. 6*s*.

Long Ashton Agricultural and Horticultural Research Station Annual Report, 1959. 15*s*.

Studies in Beef Production. E. S. Clayton. (Obtainable from the Secretary, Wye College, near Ashford, Kent).

World Wheat Statistics. International Wheat Council. Haymarket House, London. 20*s*.

Printed in England under the authority of HER MAJESTY'S STATIONERY OFFICE
by Billing and Sons Limited, Guildford and London.